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WORK PLAN LANDFILL CHARACTERIZATION AND REMEDIATION SITE H-06-L HANFORD NORTH SLOPE WASHINGTON

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APRIL 1994

United States
Department of Energy
P.O. Box 550
Richland, Washington

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MISCELLANEOUS ARCHITECT ENGINEER SERVICES FOR HAZARDOUS, TOXIC, AND RADIOLOGICAL WASTE (HTRW) PROJECTS FOR U.S. ARMY CORPS OF ENGINEERS WALLA WALLA DISTRICT

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WORK PLAN

LANDFILL CHARACTERIZATION AND REMEDIATION
SITE H-06-L
HANFORD NORTH SLOPE, WASHINGTON

CONTRACT NO. DACW68-94-D-0001

April 1994

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LIST OF ABBREVIATIONS AND ACRONYMS

AA	Atomic Absorption
Ag	Silver
ARARs	Applicable or Relevant and Appropriate Requirements
As	Arsenic
Ba	Barium
bgs	below ground surface
Cd	Cadmium
CDM Federal	CDM Federal Programs Corporation
Cr	Chromium
DOE	U.S. Department of Energy
DQCR	Daily Quality Control Report
DQOs	Data Quality Objectives
EPA	U.S. Environmental Protection Agency
ESE	Environmental Science and Engineering, Inc.
°F	degrees Fahrenheit
FID	Flame-ionization Detector
FSP	Field Sampling Plan
Hg	Mercury
HPLC	High Performance Liquid Chromatography
HSA	Hollow-Stem Auger
ICP	Inductively Coupled Plasma
IDW	Investigation Derived Waste
IRFNA	Inhibited Red-Fuming Nitric Acid
OVM	Organic Vapor Monitor
PCBs	Polychlorinated Biphenyls
PID	Photoionization Detector
PPE	Personal Protective Equipment
QA/QC	Quality Assurance/Quality Control
QAPjP	Quality Assurance Project Plan

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LIST OF ABBREVIATIONS AND ACRONYMS (CONTINUED)

RCRA	Resource Conservation and Recovery Act
Se	Selenium
SSHP	Site Safety and Health Plan
SOP	Standard Operating Procedure
SOW	Statement of Work
SVOCs	Semi-volatile Organic Compounds
TPA	Tri-Party Agreement
TPHs	Total Petroleum Hydrocarbons
µg/kg	microgram(s) per kilogram
USACE	U.S. Army Corps of Engineers
VOCs	Volatile Organic Compounds
WHC	Westinghouse Hanford Company

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1.0 INTRODUCTION

CDM Federal Programs Corporation (CDM Federal) has prepared this Work Plan for Landfill Characterization and Remediation for Site H-06-L located on the Hanford North (Wahluke) Slope, Washington, for the U.S. Army Corps of Engineers (USACE) Walla Walla District under Contract No. DACW68-94-D-0001. Activities described in this Work Plan are being conducted as a continuation of investigations initiated by the Westinghouse Hanford Company (WHC) in 1990 and 1992 to determine the total extent of buried wastes and potential waste types at this site. The Work Plan activities were developed in accordance with the USACE Statement of Work (SOW) dated February 7, 1994 and subsequent modifications.

This Work Plan is organized into five sections. Introduction and site background are presented in Section 10. Previous investigation results and initial evaluation are described in Section 2.0. The proposed approach to site characterization and remediation is outlined in Section 3.0. Section 4.0 comprises the Field Sampling Plan (FSP) for this project. The FSP includes discussion of sampling procedures, analytical methods, equipment decontamination, Quality Assurance/Quality Control (QA/QC), and Investigation Derived Waste (IDW) procedures. Section 5.0 contains references cited.

Appendices to this Work Plan include a Quality Assurance Project Plan (QAPjP) and a Site Safety and Health Plan (SSHP), analytical results from previous investigation, field forms, and Standard Operating Procedures (SOPs). A description of the purpose and content of the QAPjP and SSHP is presented later in Section 1.0.

1.1 BACKGROUND

The H-06-L Landfill Site is one of several former military sites on the Hanford North Slope which must be investigated for possible environmental hazards prior to excising the property from U. S. Department of Energy (DOE) control. A variety of remedial alternatives for the North Slope were presented in an expedited response action (ERA) proposal developed by

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DOE (1993). This ERA proposal describes each of the North Slope sites and identifies a preferred alternative which utilizes the "observational approach" (i.e. concurrent characterization and remediation). The Washington State Department of Ecology, lead regulatory agency for the North Slope ERA, concurred with the preferred alternative and provided formal approval in an Action Memorandum (1994). This action supports Milestone M-16-82 of the Hanford Tri-Party Agreement (TPA) between DOE, EPA, and the State of Washington. Milestone M-15-82 describes expedited response for the Hanford North Slope with project completion by October 1994.

The work proposed in this Work Plan constitutes the second step in implementation of the remedial alternative approved by the State. The first step of the remedy, minimization of physical hazards, is essentially complete. Data generated during the current effort will help define the scope of work necessary to characterize, and if required, remediate the remaining Hanford North Slope Landfills, to complete the remedy.

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1.2 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

This site characterization and remediation will be conducted in accordance with the following Applicable or Relevant and Appropriate Requirements (ARARs):

- 40 CFR 300, Subpart E;
- 40 CFR 61, Subpart M;
- 40 CFR 262-263;
- 49 CFR 100-177;
- The Hanford Federal Facility Agreement and Consent Order (Part 3, Article XIII, Section 38);
- The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA);
- The State of Washington Model Toxics Control Act (MTCA, Chapter 173-340 WAC);
- The State of Washington Dangerous Waste Regulation (Chapter 173-303 WAC).

1.3 OBJECTIVES AND SCOPE

The objectives of this investigation are to determine if any hazardous materials are present in disposal cells at the H-06-L Landfill, and if so, to characterize and segregate these materials for proper disposal. Accomplishment of these objectives will reduce future risks to human health and the environment and provide data to plan the level of characterization and remediation necessary at other North Slope sites. These objectives will be accomplished through the excavation of buried wastes, segregation of potentially hazardous materials using visual evidence and field screening techniques, and laboratory analyses of debris and soil samples. The scope of the investigation includes all wastes in areas of H-06-L previously defined as anomalous through geophysical surveys and field reconnaissance (WHC, 1990, 1992). In addition, further geophysical investigations will be conducted to the north, south, and between H-06-L areas previously surveyed to identify other anomalies if present. Any newly-identified anomalies will also be excavated and suspected hazardous materials will be segregated and sampled.

1.4 SITE LOCATION, DESCRIPTION, AND HISTORY

The H-06-L site is located in Grant County, Washington, in Section 34 of Township 15 North, Range 27 East (Figure 1-1). The site is divided into east and west areas by the White Bluffs Wasteway and unimproved road that intersects with State Highway 24 approximately 300 feet south of the site (Figure 1-2). The H-06-L Landfill Site (including both east and west portions) is about 20 acres in size containing approximately 8 acres of burial trenches and has an average elevation of about 680 feet above sea level (USGS 1986).

The H-06-L site is located in an area known as the North Slope of the Hanford Reservation. The North Slope consists of approximately 140 square miles of land north of the Columbia River across from the active area of the Hanford Reservation. The North Slope was homesteaded from the late 1800s until the government took control of this area in the early 1940s. Prior to government control of the North Slope, homesteaders used the land primarily

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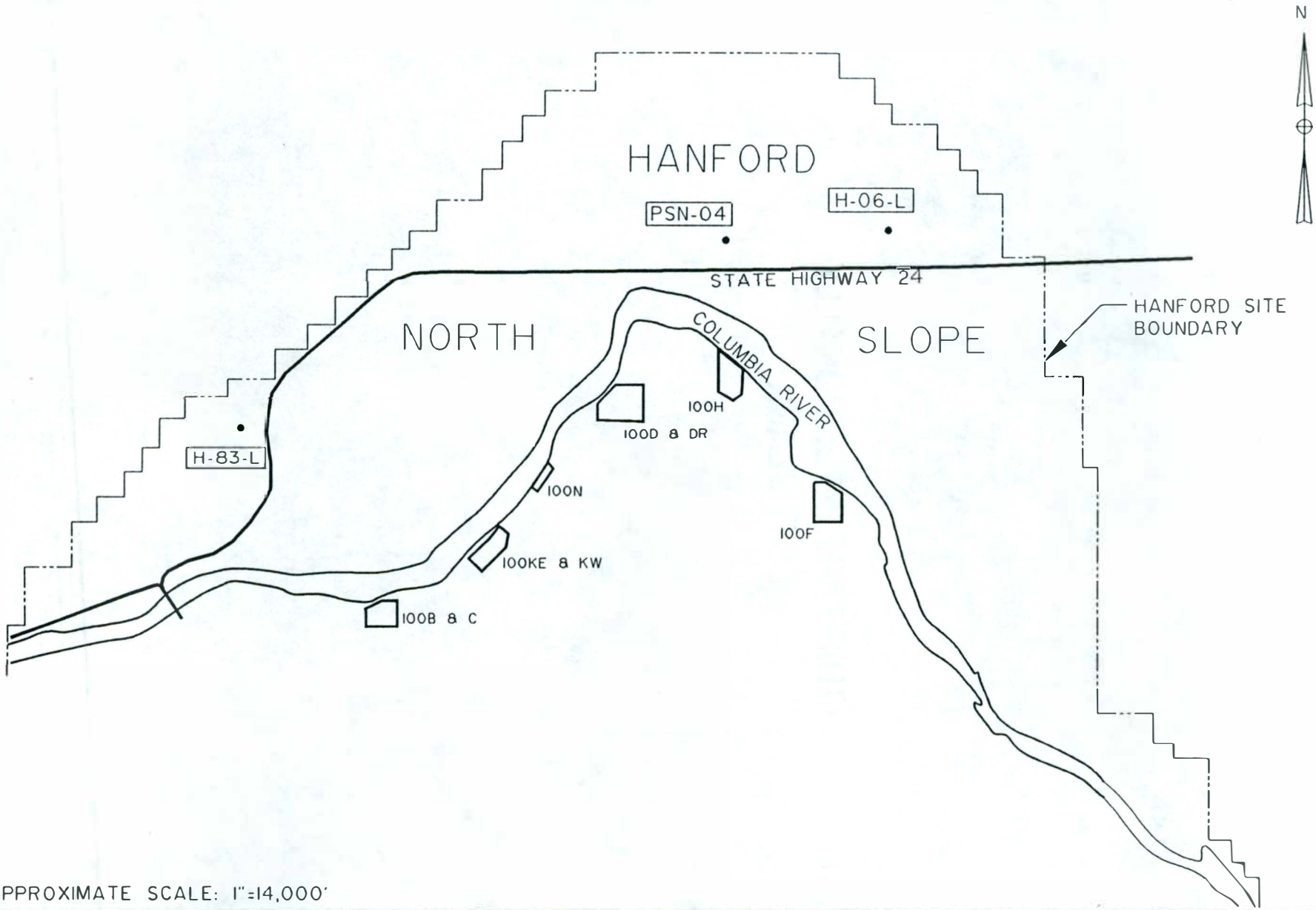

Site Location Map
Hanford North Slope, Washington

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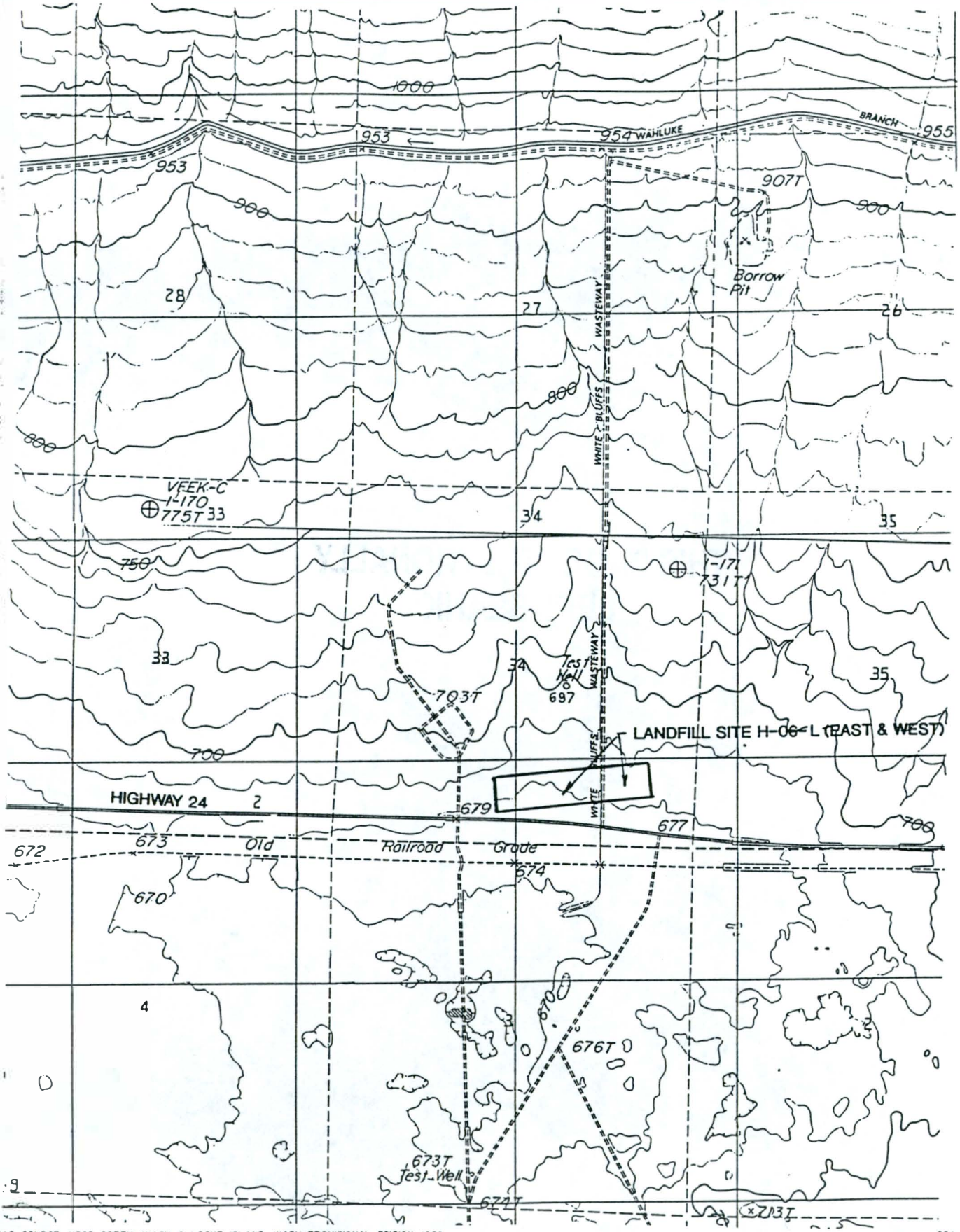

LOCATION OF LANDFILL SITE
H-06-L (EAST AND WEST)

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for grazing sheep and cattle and growing row crops and orchards. Wheat was grown on high ground away from the river. Grazing took place on land too arid or too distant from water for crops.

Additional land acquisitions took place in the 1950s for construction of the Nike Missile Air Defense System and anti-aircraft emplacements as well as to increase the buffer zone from the public lands and the production areas of the reservation. A total of seven antiaircraft gun emplacements and three Nike missile positions were located on the North Slope. These military sites were closed down in the early 1960s. Many of the military buildings were considered a potential hazard to the public and were torn down or decommissioned in the mid-1970s. Evidence remains of the existence of many of these buildings. The area has not had any active military installations on it since this period; however, the area has been used for military training maneuvers.

There are at least 10 landfills (including H-06-L East and West) associated with the former military installations on the North Slope. The specific contents of the military landfills are unknown. It is probable, based on debris scattered on the surface, that domestic trash and demolition debris were disposed of at these sites. It is possible that the missile sites may have contributed small quantities of hazardous constituents. Operational information indicates JET fuel, inhibited red-fuming nitric acid (IRFNA), aniline, hydrazine, and trichloroethylene were used in support of missile operations. Interviews with former military personnel assigned to the area indicate that these substances were used conservatively and were not normally available in large quantities (i.e., were unlikely to be disposed in the landfills). Limited vehicle maintenance activities may have contributed used motor oil to the landfills. Demolition wastes likely include asbestos-based materials such as transite (WHC 1990).

With the recent change in mission at Hanford from plutonium production to environmental cleanup, attention has been given to releasing relatively clean tracts of land for other uses. Since 1975, the area has been permitted to the Washington Department of Wildlife and the U.S. Fish and Wildlife Service. Some areas have been open to the public. Certain areas

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included in the wildlife management area have been opened for cattle grazing to ranchers who obtain grazing agreements. Some areas are currently being grazed. The eastern portion of the land contains a wasteway (bisecting the H-06-L site) used to rid local farms of runoff.

1.5 PROJECT AND ACTIVITIES AND DELIVERABLES

The H-06-L Landfill Characterization and Remediation scope of work was developed from the USACE SOW (February 1994), and includes the preparation of planning documents, implementation of the field program, preparation of data reports, and quality assurance activities. The following sections summarize these activities. Table 1-1 presents a schedule of activities and deliverables. CDM Federal will provide one unbound, reproducible copy plus four bound copies of each deliverable. Additionally a copy of text and tables included in each deliverable will be submitted on floppy disk in WP 5.2 format.

1.5.1 PLANNING DOCUMENTS

The planning documents for the Landfill Characterization Site include a Work Plan, Site Safety and Health Plan (SSHP) and Quality Assurance Project Plan (QAPjP). A summary of the information presented in each of the documents is presented in the following paragraphs.

1.5.1.1 Work Plan

This Work Plan includes a description of the site location, a history of the site and extent of the problem, and the overall project objectives. The Work Plan also describes the technical approach to characterization and remediation, as well as the samples to be collected and the type of analyses to be performed.

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TABLE 1-1

SCHEDULE OF ACTIVITIES AND DELIVERABLES

DESCRIPTION	DATE
Start Work Plan, SSHP, AND QAPP Plan	21 Feb 94
Submit Draft Plans	14 Mar 94
Review Meeting	29 Mar 94
Submit Revised Plans	08 Apr 94
Mobilize/Begin Trenching Activities	18 Apr 94
End Trenching Activities/Demobilize	29 Apr 94
Submit Draft Findings and Supplemental Work Plan	23 May 94
Submit Final Report	17 Jun 94

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1.5.1.2 Quality Assurance Project Plan

The Quality Assurance Project Plan (QAPjP) describes CDM Federal's QA/QC objectives and protocols. Specifically, the QAPjP includes project organization and responsibilities; document control procedures; quality assurance objectives for measurement data; a summary of proposed sampling activities and procedures; sample custody requirements; equipment operation, maintenance, calibration, and standardization procedures; analytical procedures; data quality management guidelines; required QA/QC samples; and quality assurance oversight activities.

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1.5.1.3 Site Safety and Health Plan

The Site Safety and Health Plan (SSHP) includes the following:

- Description of known hazards and risks associated with the site and with each activity conducted;
- Qualifications and personnel responsible for site safety and public health protection;
- Delineation of work areas, levels of personnel protection, procedure for site access, and decontamination procedures for personnel and equipment; and
- Health and safety work precautions, accident prevention, first aid, and emergency response procedures.

1.5.2 FIELD ACTIVITIES

The field program will involve the performance of several tasks related to the characterization and remediation of the H-06-L landfill. CDM Federal will provide trained personnel for the field program including: one geologist for site management, one hazardous waste specialist for sampling, at least one geophysicist (subcontractor) with equipment to survey areas to be excavated for drums and other metal objects, and a heavy equipment operator and two

laborers. Training requirements for field staff are outlined in the SSHP. The details of the field program are presented in Sections 3.0 and 4.0. A list of the field tasks to be accomplished is provided below.

- Mobilization of field program.
- Geophysical investigations.
- Excavation/trenching.
- Waste screening and segregation.
- Subsurface soil and debris sampling.
- Demobilization of field program.

1.5.3 CDM FEDERAL DELIVERABLES

The reports to be generated as a part of this landfill characterization and remediation study include Daily Quality Control Reports (DQCRs), and a Technical Report.

1.5.3.1 Daily Quality Control Reports

DQCRs will be generated daily during field activities and submitted at the end of each week to the USACE. The DQCRs will include the subcontractors and equipment on site; work performed (including samples collected and shipped); quality control activities; health and safety levels and activities; problems encountered and corrective action measures taken; and anticipated activities for the next day. A copy of the DQCR form is included in Appendix D.

1.5.3.2 Technical Report

Upon completion of the field work and receipt of all analytical results, CDM Federal will prepare the Draft Technical Report. The Draft Technical Report will be submitted to the USACE approximately 24 days after demobilization from the field. The Draft Technical Report will specifically contain the following information:

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- A brief narrative which summarizes the site location, history, and objectives of the landfill characterization and remediation.

- Field activities performed including sampling techniques.

- A description of the numbers and types of samples collected, including the dates of collection. Included with this will be a table which lists the sample numbers and any corresponding laboratory numbers required to identify analytical results for each sample. The table will also describe which samples are field QA/QC samples.

- A map showing the limits of excavated areas, location of all samples collected, and limits of geophysical surveys. The information presented on this map will not be surveyed to confirm exact locations but will be plotted in the field with respect to site features.

- An inventory of all regulated and non-regulated wastes removed from landfill disposal cells.

- A brief discussion of all sample analysis results. This will include a listing of the potential contaminants detected in each subsurface soil sample and the range of concentrations detected.

- The analytical data package from the laboratory will include detection limits for all analytes, dilution factors, and appropriate data flags; laboratory QC results including instrument blanks, method blanks, surrogate spike samples, matrix spike samples, laboratory duplicates and/or matrix spike duplicates pairs; and completed chain-of-custody forms showing sample shipment and sample preservation.

- Discussion of any conclusions and recommendations.

- An appendix containing copies of all daily QC reports.

Following receipt of comments from Walla Walla USACE and other agencies, CDM Federal will incorporate the comments into the draft report and submit a final technical report.

1.5.4 QUALITY ASSURANCE

All work performed on this project will be in accordance with CDM Federal QA requirements as described in the QAPjP and in the CDM Federal QA Manual (1993). This Work Plan has been reviewed by the project QA Coordinator, who will also maintain QA oversight for the

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duration of the project. The following deliverables produced during this investigation will be subject to technical and QA review by CDM Federal technical and QA specialists:

- Draft and Final Work Plan (including QAPjP)
- Draft and Final Technical Report

All documents developed during this project will be under the control of the CDM Federal project manager who will maintain the project files in the CDM Federal Richland office. CDM Federal policy requires that the QA Director determine when a project requires a system or performance QA audit. None are currently anticipated for this project. Additional information regarding QA requirements for this characterization and remediation project are presented in the QAPjP.

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2.0 INITIAL EVALUATION

This section presents the results of previous investigations and synthesizes the information to arrive at an initial evaluation (conceptual model) of site conditions. The information was used to develop the Work Plan Rationale (sampling approach) described in Section 3.0 and sampling procedures (Section 4.0).

2.1 SUMMARY OF PREVIOUS INVESTIGATIONS

The results of two previous investigations were obtained from three documents:

- WHC, 1990, *North Slope Investigation Report*, WHC-EP-0359, Westinghouse Hanford Company, Richland, Washington.
- WHC, 1992, *Geophysical Surveys of Military Landfills Located on Hanford's Wahluke (North) Slope*, WHC-SD-EN-ER-001, Rev. 0, Westinghouse Hanford Company, Richland, Washington.
- USDOE, 1994, *North Slope Expedited Response Action Proposal*, (DOE/RL-93-47,Rev 0), United States Department of Energy, Richland, Washington.

The two previous investigations were conducted at the H-06-L Landfill Site by WHC. The first, conducted in 1990, involved an investigation of the North Slope area to assess potential health, safety, and environmental concerns raised by the DOE, the Washington Department of Ecology, and the public. The second investigation was conducted in 1992, also by WHC, and involved performing geophysical and subsurface soil sampling investigations. The following paragraphs summarize the work performed.

2.1.1 1990 NORTH SLOPE INVESTIGATION

In 1990, WHC conducted an investigation of the North Slope area. As a result of this investigation thirty-nine sites posing potential hazards were identified on the North Slope. These sites were associated with either military or homesteading activities. Ten of the thirty-

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nine sites identified from this investigation are landfills associated with the former military installations on the North Slope including the Nike/antiaircraft H-06-L Landfill. Reconnaissance of the H-06-L Landfill Site indicated apparent soil disturbance and surface debris including paint cans, construction materials, asbestos-based materials (transite), and an asbestos brake pad.

2.1.2 1992 NORTH SLOPE INVESTIGATION

Geophysical surveys were conducted at three sites (PSN-04, H-06-L and H-83-L) on the Hanford North Slope from July 27 through August 4, 1992 (Figure 1-1). The purpose of the geophysical surveys was to characterize waste disposal practices at the three sites and to locate areas requiring further environmental investigation. To meet these objectives, magnetic and electromagnetic induction surveys were conducted in two areas totaling 20.9 acres at site H-06-L (Figures 2-1a and 2-1b). The survey areas were determined based on surface characteristics such as stressed vegetation, subsidence, and surface and partially buried debris.

Interpretation of geophysical data from the geophysical surveys allowed the anomalies (disposal areas) to be grouped into several categories as follows:

- Trenches - Longest dimensions exceeding approximately 50 ft.
- Large pits - Dimensions exceeding approximately 20 ft. x 20 ft.
- Small pits - Dimensions ranging from about 5 ft. x 5 ft. to 20 ft. x 20 ft.

The results of these surveys are documented in WHC 1992 and summarized in Table 2-1.

Areas where geophysical surveys indicated disposal sites were staked and marked. The surface of these areas were evaluated for signs of subsidence, stressed vegetation and presence of partially buried debris. Subsurface soil sampling locations were selected as close as

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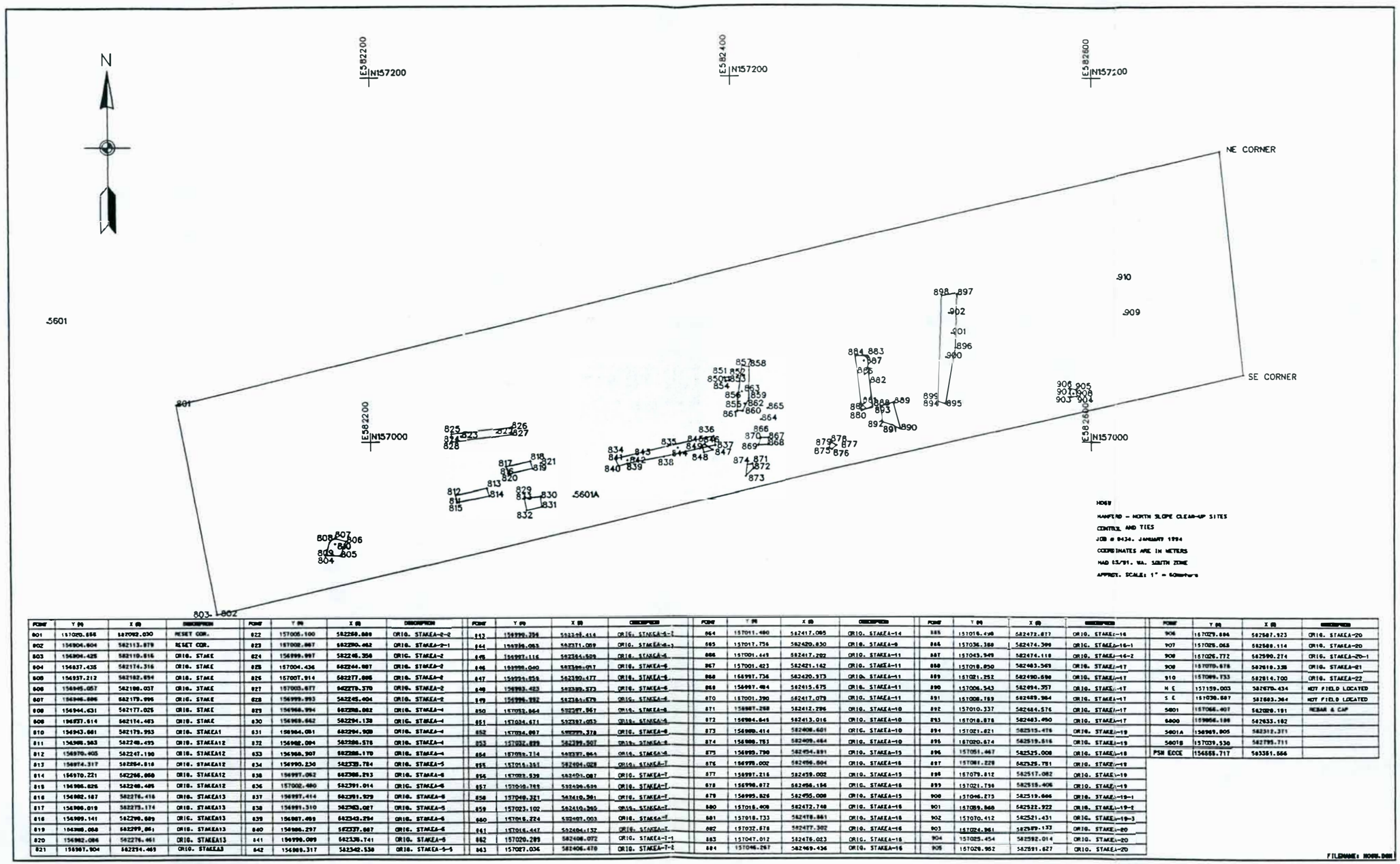

POINT	Y (N)	X (E)	DESCRIPTION
801	157020.668	582062.030	RESET COR.
802	156904.604	582113.879	RESET COR.
803	156904.425	582110.816	ORIG. STAKE
804	156837.435	582174.316	ORIG. STAKE
805	156937.212	582182.654	ORIG. STAKE
806	156945.057	582180.037	ORIG. STAKE
807	156946.886	582179.996	ORIG. STAKE
808	156944.631	582177.025	ORIG. STAKE
809	156937.614	582174.483	ORIG. STAKE
810	156943.681	582179.953	ORIG. STAKEA1
811	156988.983	582248.495	ORIG. STAKEA12
812	156970.905	582247.190	ORIG. STAKEA12
813	156974.317	582264.816	ORIG. STAKEA12
814	156970.221	582266.060	ORIG. STAKEA12
815	156986.826	582248.485	ORIG. STAKEA12
816	156982.187	582276.416	ORIG. STAKEA13
817	156986.019	582275.174	ORIG. STAKEA13
818	156989.141	582298.889	ORIG. STAKEA13
819	156988.060	582299.861	ORIG. STAKEA13
820	156982.086	582276.461	ORIG. STAKEA13
821	156987.904	582294.465	ORIG. STAKEA3
822	157005.100	582260.888	ORIG. STAKEA-2-2
823	157002.867	582290.462	ORIG. STAKEA-2-1
824	156999.997	582248.358	ORIG. STAKEA-2
825	157004.436	582244.887	ORIG. STAKEA-2
826	157007.914	582277.886	ORIG. STAKEA-2
827	157003.677	582278.370	ORIG. STAKEA-2
828	156999.993	582245.404	ORIG. STAKEA-2
829	156988.994	582288.882	ORIG. STAKEA-4
830	156989.642	582294.138	ORIG. STAKEA-4
831	156984.081	582294.908	ORIG. STAKEA-4
832	156982.084	582288.576	ORIG. STAKEA-4
833	156988.907	582288.170	ORIG. STAKEA-4
834	156990.230	582338.784	ORIG. STAKEA-5
835	156997.062	582388.293	ORIG. STAKEA-6
836	157002.480	582391.014	ORIG. STAKEA-6
837	156997.414	582391.929	ORIG. STAKEA-6
838	156991.310	582383.027	ORIG. STAKEA-5
839	156987.469	582343.294	ORIG. STAKEA-6
840	156986.297	582337.887	ORIG. STAKEA-6
841	156990.089	582338.741	ORIG. STAKEA-6
842	156989.317	582342.536	ORIG. STAKEA-5-5
843	156990.294	582348.414	ORIG. STAKEA-5-1
844	156996.063	582371.089	ORIG. STAKEA-6-1
845	156997.116	582364.509	ORIG. STAKEA-6
846	156998.040	582366.017	ORIG. STAKEA-6
847	156991.858	582390.477	ORIG. STAKEA-6
848	156983.423	582389.373	ORIG. STAKEA-6
849	156996.992	582384.678	ORIG. STAKEA-6
850	157032.864	582387.967	ORIG. STAKEA-8
851	157034.671	582387.053	ORIG. STAKEA-8
852	157034.087	582389.378	ORIG. STAKEA-8
853	157032.829	582399.507	ORIG. STAKEA-8
854	157032.714	582387.864	ORIG. STAKEA-8
855	157015.351	582404.928	ORIG. STAKEA-7
856	157023.539	582404.087	ORIG. STAKEA-7
857	157019.783	582439.639	ORIG. STAKEA-7
858	157049.321	582410.381	ORIG. STAKEA-7
859	157023.102	582410.265	ORIG. STAKEA-7
860	157015.224	582407.003	ORIG. STAKEA-7
861	157016.447	582404.137	ORIG. STAKEA-7
862	157020.295	582408.072	ORIG. STAKEA-7-1
863	157027.036	582406.470	ORIG. STAKEA-7-2
864	157011.480	582417.065	ORIG. STAKEA-14
865	157017.736	582420.830	ORIG. STAKEA-9
866	157001.449	582417.202	ORIG. STAKEA-11
867	157001.423	582421.142	ORIG. STAKEA-11
868	156997.736	582420.373	ORIG. STAKEA-11
869	156997.484	582415.675	ORIG. STAKEA-11
870	157001.390	582417.079	ORIG. STAKEA-11
871	156987.268	582412.296	ORIG. STAKEA-10
872	156984.848	582413.016	ORIG. STAKEA-10
873	156988.414	582408.601	ORIG. STAKEA-10
874	156988.783	582409.464	ORIG. STAKEA-10
875	156999.790	582454.891	ORIG. STAKEA-15
876	156998.002	582456.804	ORIG. STAKEA-15
877	156991.216	582459.002	ORIG. STAKEA-15
878	156998.872	582456.156	ORIG. STAKEA-15
879	156995.826	582455.008	ORIG. STAKEA-15
880	157018.608	582472.748	ORIG. STAKEA-16
881	157018.733	582478.861	ORIG. STAKEA-16
882	157032.678	582477.302	ORIG. STAKEA-16
883	157047.012	582478.023	ORIG. STAKEA-16
884	157046.267	582469.436	ORIG. STAKEA-16
885	157016.498	582472.017	ORIG. STAKEC-16
886	157036.358	582474.398	ORIG. STAKEA-16-1
887	157049.949	582474.118	ORIG. STAKEA-16-2
888	157018.850	582483.563	ORIG. STAKEA-17
889	157021.252	582490.698	ORIG. STAKEA-17
890	157006.543	582494.357	ORIG. STAKEA-17
891	157008.189	582489.964	ORIG. STAKEA-17
892	157010.337	582484.576	ORIG. STAKEA-17
893	157018.878	582483.450	ORIG. STAKEA-17
894	157021.621	582515.476	ORIG. STAKEA-19
895	157020.674	582519.516	ORIG. STAKEA-19
896	157051.467	582525.008	ORIG. STAKEA-18
897	157081.228	582525.751	ORIG. STAKEA-19
898	157079.812	582517.082	ORIG. STAKEA-19
899	157021.738	582519.406	ORIG. STAKEA-19
900	157046.275	582519.666	ORIG. STAKEA-19-1
901	157059.860	582522.922	ORIG. STAKEA-19-2
902	157070.412	582521.431	ORIG. STAKEA-19-3
903	157024.861	582589.133	ORIG. STAKEA-20
904	157025.454	582592.014	ORIG. STAKEA-20
905	157028.952	582591.827	ORIG. STAKEA-20
906	157029.884	582587.923	ORIG. STAKEA-20
907	157026.065	582588.114	ORIG. STAKEA-20
908	157026.772	582590.274	ORIG. STAKEA-20-1
909	157070.678	582610.338	ORIG. STAKEA-21
910	157069.733	582614.700	ORIG. STAKEA-22
N E	157159.003	582678.434	NOT FIELD LOCATED
S E	157038.587	582683.364	NOT FIELD LOCATED
5801	157066.407	582289.191	REBAR & CAP
6800	159956.186	582633.182	
5801A	158969.805	582312.371	
5801B	157039.536	582795.711	
PSH ECCE	156555.717	583351.556	

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HANFORD NORTH SLOPE
SITE MAP WITH GEOPHYSICAL INTERPRETATION
LANDFILL SITE H-06-L WEST (WHC, 1992)

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Figure 2-1a

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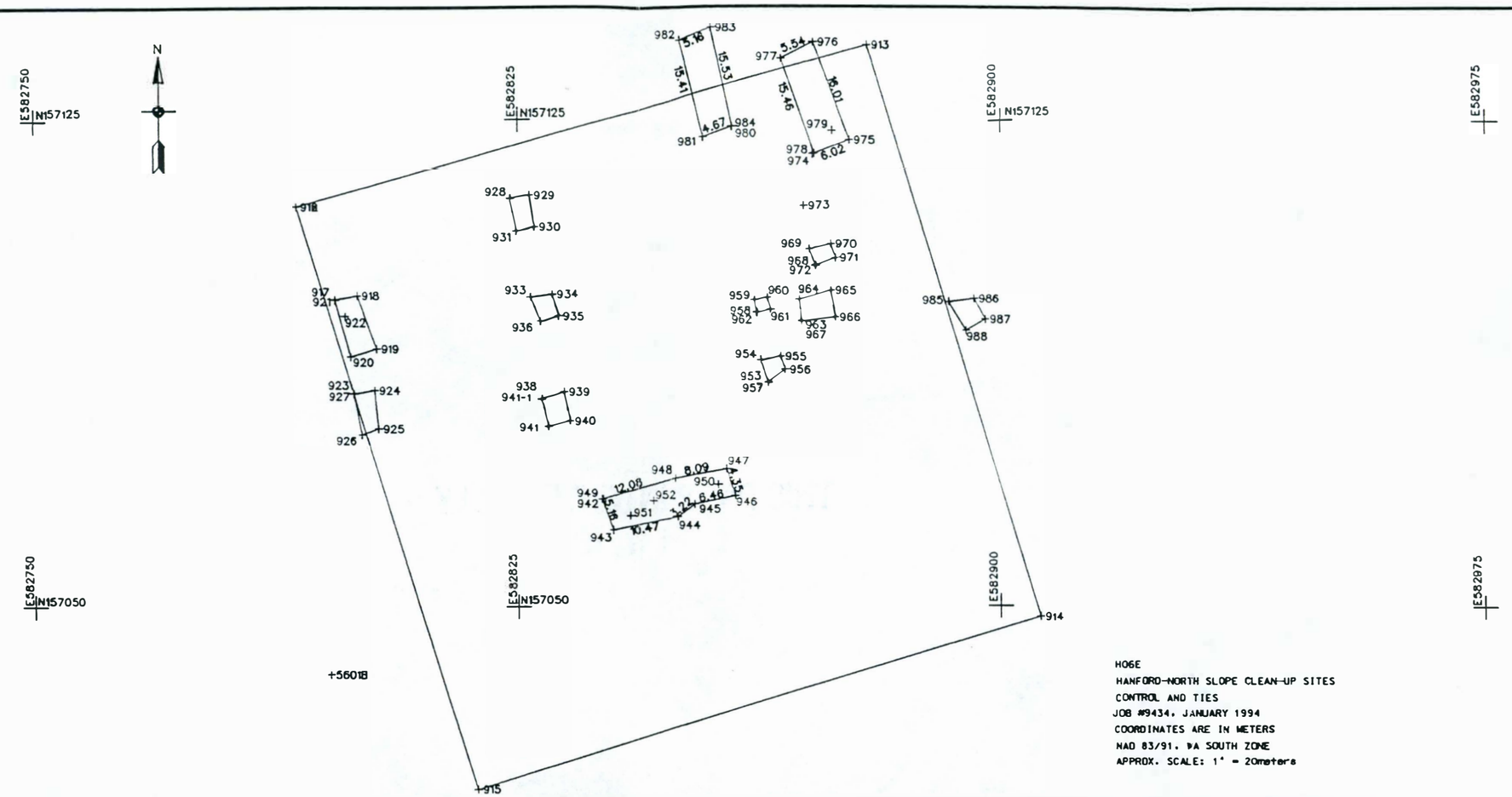

H06E
HANFORD-NORTH SLOPE CLEAN-UP SITES
CONTROL AND TIES
JOB #9434, JANUARY 1994
COORDINATES ARE IN METERS
NAD 83/91, WA SOUTH ZONE
APPROX. SCALE: 1" = 20meters

POINT	Y (N)	X (E)	DESCRIPTION	POINT	Y (N)	X (E)	DESCRIPTION	POINT	Y (N)	X (E)	DESCRIPTION	POINT	Y (N)	X (E)	DESCRIPTION
912	157111.622	582790.529	ORIG. COR.	933	157097.796	582826.953	ORIG. STAKEA-4	954	157087.952	582862.982	ORIG. STAKEA-7	975	157121.760	582876.604	RESET STAKEA-12
913	157136.344	582879.286	ORIG. COR.	934	157098.202	582830.295	ORIG. STAKEA-4	955	157088.534	582866.016	ORIG. STAKEA-7	976	157136.765	582871.031	RESET STAKEA-12
914	157048.404	582906.232	ORIG. COR.	935	157094.836	582831.261	ORIG. STAKEA-4	956	157086.504	582866.697	ORIG. STAKEA-7	977	157134.249	582866.099	RESET STAKEA-12
915	157021.542	582818.626	ORIG. COR.	936	157094.093	582828.514	ORIG. STAKEA-4	957	157084.591	582864.094	ORIG. STAKEA-7	978	157119.710	582871.220	RESET STAKEA-12
916	157111.639	582790.550	ORIG. COR.	937	157097.765	582826.985	ORIG. STAKEA-4	958	157095.243	582862.393	ORIG. STAKEA-10	979	157123.202	582873.946	ORIG. STAKEA-12-2
917	157097.368	582796.559	ORIG. STAKEA-2	938	157082.137	582828.678	ORIG. STAKEA-3	959	157097.129	582862.026	ORIG. STAKEA-10	980	157123.824	582858.467	RESET STAKEA-11
918	157098.021	582800.083	ORIG. STAKEA-2	939	157083.277	582832.077	ORIG. STAKEA-3	960	157097.513	582864.029	ORIG. STAKEA-10	981	157122.246	582854.070	RESET STAKEA-11
919	157089.912	582803.108	ORIG. STAKEA-2	940	157078.731	582833.029	ORIG. STAKEA-3	961	157095.743	582864.520	ORIG. STAKEA-10	982	157137.213	582850.421	RESET STAKEA-11
920	157088.658	582799.061	ORIG. STAKEA-2	941	157077.886	582829.733	ORIG. STAKEA-3	962	157095.190	582862.512	ORIG. STAKEA-10	983	157139.022	582855.256	RESET STAKEA-11
921	157097.312	582796.579	ORIG. STAKEA-2	942	157066.554	582837.967	ORIG. STAKEA-6	963	157093.998	582869.327	ORIG. STAKEA-8	984	157123.854	582858.595	RESET STAKEA-11
922	157094.838	582798.160	ORIG. STAKEA-2-1	943	157061.720	582839.761	ORIG. STAKEA-6	964	157097.324	582868.885	ORIG. STAKEA-8	985	157096.878	582891.927	RESET STAKEA-14
923	157082.973	582799.587	ORIG. STAKEA-1	944	157063.782	582850.029	ORIG. STAKEA-6	965	157098.634	582873.766	ORIG. STAKEA-8	986	157097.375	582895.910	RESET STAKEA-14
924	157083.490	582802.747	ORIG. STAKEA-1	945	157065.702	582852.620	ORIG. STAKEA-6	966	157094.606	582874.481	ORIG. STAKEA-8	987	157094.255	582897.690	RESET STAKEA-14
925	157077.566	582803.380	ORIG. STAKEA-1	946	157067.024	582858.942	ORIG. STAKEA-6	967	157093.951	582869.303	ORIG. STAKEA-8	988	157092.512	582894.646	RESET STAKEA-14
926	157076.630	582800.780	ORIG. STAKEA-1	947	157071.156	582857.589	ORIG. STAKEA-6	968	157102.544	582871.362	ORIG. STAKEA-9	5601	157066.407	582020.191	REBAR & CAP
927	157082.958	582799.467	ORIG. STAKEA-1	948	157069.728	582849.621	ORIG. STAKEA-6	969	157105.040	582870.425	ORIG. STAKEA-9	6800	159856.188	582633.182	
928	157112.965	582823.883	ORIG. STAKEA-5	949	157066.565	582838.144	ORIG. STAKEA-6	970	157105.829	582873.769	ORIG. STAKEA-9	5601A	156969.805	582312.371	
929	157113.392	582826.865	ORIG. STAKEA-5	950	157068.690	582856.304	ORIG. STAKEA-6-1	971	157103.711	582874.407	ORIG. STAKEA-9	5601B	157039.530	582795.711	
930	157108.494	582827.629	ORIG. STAKEA-5	951	157063.955	582842.449	ORIG. STAKE	972	157102.637	582871.420	ORIG. STAKEA-9	941-1	157082.060	582828.749	ORIG. STAKEA-3
931	157107.896	582824.844	ORIG. STAKEA-5	952	157066.269	582846.092	ORIG. STAKE	973	157111.746	582869.602	ORIG. STAKEA-13	PSN ECCE	156555.717	583351.556	
932	157112.864	582823.866	ORIG. STAKEA-5	953	157084.475	582864.118	ORIG. STAKEA-7	974	157119.586	582870.994	RESET STAKEA-12				

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HANFORD NORTH SLOPE
SITE MAP WITH GEOPHYSICAL INTERPRETATION
LANDFILL SITE H-06-L EAST (WHC, 1992)

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Figure 2-lb

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TABLE 2-1

INTERPRETATIONS OF GEOPHYSICAL DATA FROM H-06-L SITE (SUMMARIZED FROM WHC 1992)

Site	Anomaly*	Interpretation
H-06-L East	A-1	Near-surface metallic debris (>3 ft?)
	A-2	Near-surface metallic debris (>3 ft?)
	A-3	Near-surface metallic debris
	A-4	Near-surface metallic debris (small quantity?)
	A-5	Near-surface metallic debris (small quantity?)
	A-6	Large (15 ft x 60 ft) trench containing buried metallic and non-metallic debris
	A-7	Near-surface metallic debris
	A-8	Near-surface metallic debris
	A-9	Partially buried liquid-bearing paint cans
	A-10	Near-surface metallic debris, (small quantity?)
	A-11	Large trench containing buried metallic and non-metallic debris (may extend up to 175 ft north of mapped area and south to include A-10 and A-7).
	A-12	Large (15 ft x 40 ft) trench containing buried metallic and non-metallic debris
	A-13	Single metallic object or small pit
	A-14	Near-surface metallic debris
	A-15	Single metallic object or small pit, not shown on map
H-06-L West	A-1	Large pit containing buried metallic debris, some at surface.
	A-2	Trench containing metallic and non-metallic debris; predominantly non-metallic; evidence of subsidence; stressed vegetation
	A-3	Small buried metallic object
	A-4	Large pit containing buried metallic debris, some at surface
	A-5	Trench with significant amounts of near-surface metallic debris, some metallic debris exposed.

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TABLE 2-1 (Continued)

INTERPRETATIONS OF GEOPHYSICAL DATA FROM H-06-L SITE
(SUMMARIZED FORM WHC 1992)

Site	Anomaly*	Interpretation
H-06-L West (Continued)	A-6	Small pit containing metallic debris, some at surface
	A-7	Trench with metalli c and non-metallic debris
	A-8	Small pit containing metallic debris, some at surface
	A-9	Small buried metallic object
	A-10	Small pit containing metallic debris
	A-11	Small pit containing metallic debris
	A-12	Large pit with minor metallic and significant non-metallic debris
	A-13	Large pit with minor metallic and significant non-metallic debris
	A-14	Small buried metallic object
	A-15	Small pit containing metallic debris
	A-16	Trench containing significant amounts of near-surface metallic debris
	A-17	Large pit containing near-surface metallic debris
	A-18	Small buried metallic object
	A-19	Trench with weak magnetic/EM-31 signal; stressed vegetation; slight subsidence; significant non-metallic debris? (> 4 ft.?)
	A-20	Small pit containing metallic debris
	A-21	Small buried metallic object
	A-22	Small buried metallic object

* Locations of individual anomalies are presented on Figure 2-2.

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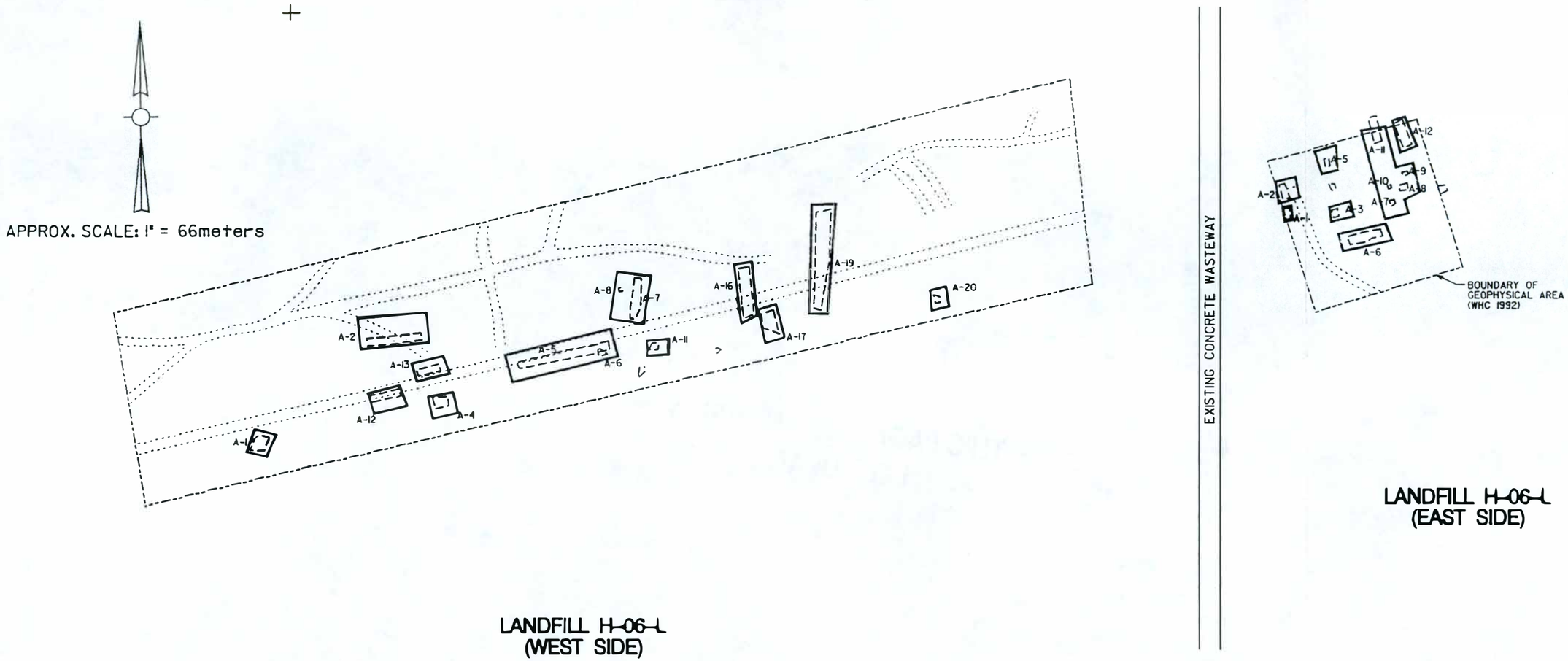

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GEOPHYSICAL SURVEY AREAS AND ANOMALIES IDENTIFIED IN WHC, 1992

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Figure 2-2

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possible to the center of the more significant anomalies and near areas of subsidence or stressed vegetation.

A hollow-stem auger rig was used to obtain the subsurface soil samples. Cuttings from the auger were screened for organic vapors at 2-ft intervals using an organic vapor monitor (OVM). Debris associated with the cuttings included wood, metal drums and cans, and transite.

Field screening was used to determine the scope of sampling at each location. Screening samples were taken at approximately the 6- and 10-ft levels (bottom of the landfill was estimated to be 9 to 11 ft). At least one sample was collected from each anomaly drilled for analysis at an offsite laboratory.

Field screening analysis included pH, heavy metals, and volatile organic compounds depending on sample characteristics (i.e., color and OVM readings). Offsite laboratory analysis included volatiles and semi-volatiles; pesticide/herbicide, polychlorinated biphenyls (PCB); inductively coupled plasma (ICP) and atomic absorption (AA) analyses for metals (including mercury); anions, chromium VI, total petroleum hydrocarbons, and total activity analysis. A total of 36 samples from 45 augering locations were taken from the three landfills for analysis at offsite laboratories (see Appendix C for results). This included six samples from Nike position H-83-L, sixteen from Nike position H-06-L, eight from anti-aircraft position PSN-04, and six quality assurance/quality control (QA/QC) samples. A total of 90 field screening samples were taken during this effort (two per auger boring). Samples collected during this investigation indicated no hazardous materials present at the landfill other than non-friable asbestos-containing building materials.

2.2 CONCEPTUAL MODEL

Site investigations and sampling (WHC 1992) supported the conclusions reached earlier (WHC 1990) based on records review and interviews that little or no hazardous material was

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disposed in the H-06-L site. Primary constituents in the disposal trenches and pits are probably construction debris, residential and office trash, scrap metal, paint and oil cans, and other non-hazardous materials. Some construction materials disposed at the site contained asbestos (e.g., transite); however, it is expected that this asbestos-containing material is almost exclusively non-friable and therefore, non-regulated. Some minor quantities of liquid paints, oils, or solvents may have been disposed also. Most of these fluids are expected to have been absorbed by landfill debris and soils and may be significantly degraded. A neutralization pit for acids from the Nike site has never been identified. This pit may be located during excavation. There is a small potential for ordnance (small arms or anti-aircraft artillery ammunition duds) to be present in the landfills.

Wastes are present in small to large pits, elongate trenches, and possibly in small isolated burial locations. Cover materials are expected to range from 0 to 5 ft thick with maximum depth of burial anticipated to be about 9-11 ft. The largest known disposal feature is anomaly A-11 in H-06-L East. This disposal trench may be as long as 325 ft.

There is no evidence for disposal at H-06-L of large quantities of liquid wastes. Therefore it is assumed that subsurface migration of waste constituents has been minimal. During the investigation, disposal features will be excavated until all stained and suspect contaminated materials have been removed, subject to the limitations of the excavation equipment. If contamination continues beyond the depth which on-site equipment can excavate, the depth reached will be documented and additional investigation postponed pending analytical laboratory results from samples collected at that depth.

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3.0 WORK PLAN RATIONALE

Design of the sampling approach is driven by waste types, site conditions and the goals and objectives of the project. These aspects of the H-06-L site characterization and remediation were presented in previous sections. This section synthesis the information presented to arrive at a sound approach to achieve project goals and objectives.

3.1 COMPLETE DELINEATION OF BURIAL SITES

In order to provide the greatest reduction in potential risks posed by buried wastes at the H-06-L Site, and to ensure that data collected are representative of the entire site, it will be necessary to complete the delineation of burial sites. Fifteen individual burial sites (as interpreted from geophysical anomalies) have been identified at H-06-L East. Twenty-two sites have been identified at H-06-L West. Based on the location and orientation of these anomalies (Fig 2-1 and 2-2), and on conditions observed in the field (disturbed earth, stressed vegetation), it has been determined that additional geophysical studies are warranted north of H-06-L East, south of H-06-L West, and between these two previously surveyed areas. Survey methods will be based on techniques and procedures employed in the earlier study (WHC 1992). Details of the proposed survey are presented in Section 4.0.

3.2 EXCAVATION AND SEGREGATION OF WASTES

Previous investigations collected subsurface soil and debris samples from borings drilled into areas of geophysical anomalies. While data generated from these studies suggested that contamination by hazardous materials was not present, samples represented a very small portion of the waste in a few selected anomalies. In order to evaluate the presence or absence of hazardous material contamination with the greatest degree of confidence, each anomaly will be excavated in its entirety. Waste materials considered to contain hazardous constituents will be physically segregated based on visual evidence and field screening techniques. The locations of previously documented anomalies will be staked by USACE

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prior to commencement of work. Geophysical instruments will be used to confirm the lateral extent of buried debris prior to excavation.

3.3 SUBSURFACE SOIL AND DEBRIS SAMPLING

Potentially hazardous materials segregated from non-regulated wastes will be sampled to determine what hazardous constituents (if any) are present and at what concentrations. These data will allow for proper disposition of hazardous and non-hazardous materials and will support decisions regarding the types and level of characterization and remediation activities warranted at other Hanford North Slope former military sites.

Waste materials determined to be non-regulated based on the field screening and laboratory analytical data will be returned to the excavation. Finer-grained material (if originally present) will be returned as a cap and will be compacted with excavation equipment. Non-regulated materials to be returned to the excavations will include non-friable asbestos-containing materials, if present.

Any friable asbestos identified during excavation will be handled on a contingency basis by another USACE contractor. Procedures for friable asbestos handling, packaging, and disposal will be developed in a separate field planning document.

Similarly, any ordnance observed during site characterization will be the responsibility of the USACE Ordnance Specialist onsite during excavation. Ordnance handling and disposal will be addressed in a separate ordnance plan developed for the project by the USACE.

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4.0 FIELD SAMPLING PLAN

The FSP presents a description of the activities or tasks, and procedures which will be employed to accomplish project objectives in a safe and efficient manner. This section is divided into four main topics, Section 4.1. Field Activities, describes the site operations and surveys which are necessary precursors or adjuncts to excavation of the landfill waste cells. Section 4.2, Geophysical Surveys, describes methods and protocols to be used in the conduct and reporting of geophysical surveys to locate any unidentified burial sites and to confirm the limits of known anomalies. Section 4.3, Waste Excavation, presents procedures to be used for excavation and site restoration. Section 4.4, Field Sampling, outlines the procedures and protocols to be used in sampling and analysis of subsurface soil and debris.

Appendix E contains the following CDM Federal Standard Operating Procedures (SOPs):

- 1-2 Sample Custody
- 1-4 Subsurface Soil Sampling
- 2-5 Packing and Shipping of Environmental Samples
- 4-1 Field Logbook Content and Control
- 5-1 Control of Measurement and Test Equipment

The procedures presented in this section provide additional site-specific detail which may not be discussed in the SOPs. The site-specific procedures described below will be followed during this investigation. For additional information, refer to the SOPs.

4.1 FIELD ACTIVITIES

The paragraphs below discuss various surveys, clearances, and other activities conducted in support of the H-06-L landfill characterization and remediation.

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4.1.1 UTILITY CLEARANCES

Utility clearances will be obtained by CDM Federal from the appropriate utility companies before performing any excavation. Proposed excavation locations will be evaluated by utility company representatives to ensure that no underground utilities exist. If underground utilities are present, proposed excavation locations in question may need to be relocated to avoid the utility.

4.1.2 UNEXPLODED ORDNANCE ASSESSMENT

The potential for excavation to expose munitions has been stated by the USACE to be minimal. A representative of USACE, experienced and qualified for explosive identification, will clear all areas prior to excavation activities and will evaluate any potential ordnance materials discovered during excavations. The USACE ordnance specialists will operate according to a separate ordnance plan prepared for this project.

4.1.3 RADIOLOGICAL SURVEY

A radiological survey of the H-06-L landfill site was conducted on March 19 and 20, 1994 by WHC. The survey was conducted using the Mobile Surface Contamination Monitor II (MSCM-II or "Rad Rover") for automated recording of gross beta/gamma radiation levels at or near six inched from the surface soil. The MSCM-II is equipped with instrumentation which used global positioning systems (GPS) to provide location control.

Preliminary results from the radiological survey indicate no evidence of surface or subsurface contamination. Data originally obtained with the MSCM-II suggested elevated radiation/contamination at 24 points within H-06-L west and 12 points within H-06-L east. More detailed surveys of these suspect locations utilizing hand-held instrumentation showed no evidence of contamination.

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CDM Federal will provide instrumentation and trained personnel for radiological screening during the current characterization and remediation project. Information on radiological screening is provided in the SSHP (Appendix B).

4.1.4 FLORA AND FAUNA SURVEY

A flora and fauna survey has been conducted in each area where ground disturbance will likely occur. A follow-up survey was also conducted to evaluate seasonal changes in faunal populations and differences in evidence of floral species present. Data from these surveys will be used to assure impacts to potential endangered or threatened environmental species and wildlife will be minimized.

4.1.5 CULTURAL RESOURCES

A cultural resource review of the waste sites on the North Slope, including H-06-L, was performed in August 1993. All but five of the identified waste sites were considered insignificant. The five significant sites; the Homestead, Stock Tank, Overlook, 12-3, and Wagon Road Cisterns are considered to be significant because they provide information about early Euro-American activities on the Hanford Site. Because excavation will occur in previously disturbed areas, there is little chance of encountering Indian tribal cultural materials. During the conduct of this characterization and remediation, work will be halted in the event Indian tribal cultural resources are discovered. The USACE will be consulted before work resumes at any location where suspected Indian cultural resources are discovered. Federal law prohibits the unauthorized removal of cultural artifacts from federally controlled lands.

4.2 GEOPHYSICAL SURVEYS

The general approach for the delineation of landfill cells at the H-06-L site will be to identify areas of anomalous geophysical response indicative of buried objects and disturbed soils.

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Three geophysical techniques have been selected for this survey, electromagnetic profiling (EM), magnetics (MAG) and ground penetrating radar (GPR). These techniques have been selected to provide information on the presence of buried metal, changes in soil conductivity and buried objects. Both the EM and MAG can identify buried ferrous metal which might be found in the landfill. In addition, the EM can also detect changes in soil conductivity which might indicate the presence of non-ferrous metal or other materials expected to be present in the landfill. GPR provides information on the refinement of anomaly boundaries and the location of metallic and non-metallic buried objects. The combination of the three techniques has proven to provide a higher degree of confidence in the interpretation of the individual data sets and in the survey as a whole. In addition, the Fisher M-Scope pipe and cable locator will be used to identify shallow metal objects to fine-tune the interpretation of the presence of landfill material.

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Geophysical data will be collected along parallel survey transects to identify and map areas of anomalous geophysical response. These areas will be marked in the field and their locations recorded on hand-drawn field maps. The maps will be available on a quick turnaround basis to direct subsequent trenching operations. Upon completion of the geophysical survey, the results of the geophysical survey will be presented in the technical report and will include maps showing the locations of identified anomalies and text describing an interpretation of the subsurface conditions at the anomaly locations. The report will also include a description of geophysical methods and field procedures used.

4.2.1 GEOPHYSICAL EQUIPMENT

The MAG system consists of two EG&G Geometrics, Inc. Model G-856 proton precession gradient magnetometers. The field instrument, which is carried along the survey transects, has enhanced memory and is capable of storing nearly 10,000 measurements in memory. The second magnetometer is placed in a fixed location and is used to monitor naturally occurring variations in the earth's magnetic field.

The EM system consists of a Geonics Limited Model EM31-D terrain conductivity meter connected to both a digital data logger and a two-channel chart recorder. The analog chart recorder output allows the geophysicist to continuously monitor the EM response while walking along the survey transects. This method of EM data collection has the advantage of facilitating rapid recognition of areas of anomalous response that may require an extension of the survey area or additional, more closely spaced survey transects. Moreover, because there is no computer processing of the analog data, preliminary EM anomaly maps can be quickly prepared. The digital data is returned to the office for processing and computer contouring.

A second electromagnetic detector, the Fisher Research Laboratory model TW-6 M-Scope pipe and cable locator, will also be used during this investigation. This unit does not have a recording function, but it produces an audible signal when held within approximately 4 feet of metal objects. It is useful for quickly delineating areas of shallow buried metal.

A Geophysical Survey System, Inc. (GSSI), Model SIR-8 ground penetrating radar with a 500 megahertz (MHz) and 300 or 120 MHz antenna may also be used. Under favorable conditions, GPR can be used to image buried objects, excavation boundaries, and areas of disturbed soils. GPR uses radar technology to generate a continuous high resolution profile of the subsurface by reflecting radar signals off boundaries between media having different electrical properties, such as sand and wood. The depth of penetration of the GPR signal depends on the soil conductivity; in sandy soils this can be as deep as 10 feet or more, in moist, clayey soils this can be 3 to 5 feet or less.

4.2.2 DATA QUALITY OBJECTIVES

The data quality objectives of the geophysical survey is to acquire data of sufficient quality to satisfy the survey objectives, i.e., to delineate landfill cell boundaries at the site. Although data quality is generally site specific, quality assurance steps have been incorporated into the data collection procedures to minimize the possibility that equipment malfunction and/or operation error affect data quality and impair the survey objectives. These steps, generally

involving equipment functional checks, rigorous calibration procedures, and data repeatability checks, are outlined in the survey procedures section.

4.2.3 SURVEY PROCEDURES

Geophysical surveys will be conducted at three areas. The first is an approximately 100- by 2,000-foot southern extension of the previously surveyed (WHC 1992) portion of Landfill H-06-L, west of the concrete wasteway. The second area is an approximately 100- by 300-foot northern extension of the previously surveyed whc 1992 portion of Landfill H-06-L, east of the wasteway. The third area is an approximately 400- by 500-foot area between the two previously surveyed portions of Landfill H-06-L, and is dissected by the concrete wasteway. The surveys will include verifying the locations of previously identified anomalies in conjunction with work at the above unsurveyed areas.

A 20-foot grid pattern will be established in the survey areas using a survey transit and fiberglass tape measure. The grid spacing was chosen to provide the necessary detail for the survey and to match the grid spacing of previous surveys. The grid points will be labeled and marked by combination of wooden survey lath and PVC pin flags. The survey transects will be referenced to the previous survey grid should sufficient control points remain in place. If not, the grid will be referenced to a prominent site feature such as the concrete wasteway.

Before geophysical surveying begins operational checks will be made on all functional components of the geophysical systems, and each system will be tuned to local conditions according to the manufacturers' operations manuals. A calibration point for the EM and a MAG base station location will be established in an area of native soil as determined during a walk-around survey. EM system calibration and magnetometer tuning will be performed before each day's data collection.

EM data will be collected along transects spaced 20 feet apart; continuous, two-channel analog EM data will be obtained using the chart recorder, in addition, the two components of

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the EM signal will also be obtained at one-second intervals by the digital data logger. MAG data will be collected along transects spaced 20 feet apart with magnetic gradient readings taken every 10 feet along the survey transects. The MAG transects will be offset 10 feet from the EM transects, resulting in a 10-foot transect spacing for the entire geophysical survey.

As a data quality check, selected transects will be resurveyed at the beginning of each days' surveying. In general, the last transect surveyed each day will be resurveyed the following morning. In addition, at the beginning of each days' surveying, the MAG operator will take magnetic measurements along a baseline. As the days' surveying progresses, the baseline stations will be reoccupied so that time-varying magnetic noise can be monitored. Also, at selected stations, several successive magnetic strength readings will be taken to validate instrument sensitivity and reproducibility and to check for short period magnetic noise (micropulsations or sunspot activity).

EM and MAG data will be periodically downloaded from the instruments' memory to a laptop computer, and copied onto backup disks. The data filenames and survey transect names will be recorded in the geophysicist's field log. The analog EM data records will be reviewed to insure that they are properly annotated with transect number, horizontal stationing, instrument setting and scaling information. MAG data will be output to a line printer and similarly annotated. MAG output will also be inspected for anomalous responses indicative of buried metal.

A site features map will be prepared for each survey area to show significant topographic features and the locations of surface objects that could affect geophysical measurements. A preliminary results map will also be prepared. This map will be used to direct the GPR survey. GPR is generally limited to areas with vehicle access. Should site conditions permit, GPR profiles will be obtained in areas of anomalous EM and MAG response to determine detected objects' burial depth, if possible, and better define the lateral extent of the landfill cells.

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4.2.4 DATA REDUCTION AND REPORTING

Data reduction and reporting will proceed in two phases: a field phase and an office phase. During the field phase, hand-drawn maps will be generated showing preliminary results on a quick turnaround basis so that data regarding anomalous areas are available immediately for guiding excavation activities.

For the field data reduction phase, analog EM records will be viewed side-by-side to help identify localized anomalies indicative of small amounts of buried wastes, and larger anomalies appearing on more than one transect that are indicative of areas of more widespread landfilling. Viewing the analog data is important because the more localized anomalies tend to be smoothed away during computer contouring of digital data. Although the MAG instrument has no analog output, areas of anomalous response can often be identified from the MAG data printout. As the geophysical survey proceeds, the anomaly location maps will be updated to incorporate additional findings.

During the office phase of the data reduction and reporting work, the digital EM data will be passed through a computer program that separates the EM in-phase and conductivity traces into separate data files and assigns X-Y grid coordinates used for computer contouring. MAG data will be processed using EG&G, Geometrics' MAGPAC software program to prepare magnetic total field and magnetic gradient data files for computer contouring. Computer contour maps will be generated using the Geosoft Mapping System, by GEOSOFT, Inc., of Toronto, Canada. The contour maps will be inspected for areas of anomalous response indicative of subsurface disposal. Profiles of MAG response may also be prepared using the GRAPHER program by Golden Software, Inc. The anomalous areas as determined from the contour maps will also be plotted on the site features map to produce a final anomaly location map.

An anomaly location map will be prepared along with a magnetic gradient contour map and an EM in-phase contour map. Contour maps of EM conductivity and magnetic total field

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may also be presented. The report text will include a description of the survey areas, field and quality control procedures, a discussion of the data analysis and interpretation procedures, and a section presenting the survey findings, with discussion. A discussion of geophysical methods and equipment will be included in an appendix.

4.3 WASTE EXCAVATION

Caution will be exercised to protect the fragile arid environment when performing any work activities. CDM Federal will use existing roads at all times, unless directed otherwise by the USACE, to protect vegetation and minimize fire danger. Vehicle widths will not exceed the width of the road. CDM Federal will protect all trees and shrubs in any work area to the extent practicable. When performing work, CDM Federal will use methods that have the least impact on the sagebrush/grasslands. Work activities will be performed only in previously disturbed areas.

The work activities will consist of inventorying and segregating any potentially hazardous materials excavated from the trenches. The work sequence will be as follows:

- Remove landfill caps with dozer (NLT 215 hp) and stockpile finer grain material for subsequent closure of the excavated area.
- The selected areas for excavation (Figure 4-1) at the H-06-H (East and West) landfill areas will be field staked by the USACE.
- Place the backhoe tractor (1 to 1 1/4 cubic yard (cy) bucket capacity) in a safe position. This will be based on the operators judgement and site conditions.
- The proposed trenching will consist of linear excavations approximately 2 to 3 feet wide, 10 to 20 feet long and 9 - 11 feet deep (maximum).
- Excavated materials will be placed on the ground, a sufficient distance from the excavation so as not to return excavated materials to the trench.
- Excavated materials will be screened visually and by field instruments.

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- Inventory and segregate (by shovel or backhoe) potentially hazardous materials found during the excavation and/or screening operation.

- If asbestos-containing materials are encountered during waste excavation or segregation, a qualified USACE representative will be consulted to determine if the asbestos is friable or non-friable. Non-friable asbestos will be treated as a non-regulated waste and will be returned to the disposal cell. Friable asbestos will be handled, packaged, and labeled for appropriate disposal by a USACE contingency contractor.

- All potentially hazardous materials will be stockpiled at a staging area (adjacent to the excavation) consisting of USACE-furnished Port-A-Pads (30 mil thick PVC sheets, about 8 feet by 27 feet in size).

- At the direction of the USACE, sample and test any potentially hazardous materials. Personnel will never enter any open trench greater than four feet deep.

- Refer to decision chart (Appendix F) for procedures to be followed in the event that containers containing liquids are discovered during excavation.

- All pertinent field QA/QC documentation, logbooks, sample labels and field site sheets shall be completed prior to refilling the trench.

- Before backfilling, information regarding the trench will be recorded including site number, trench number, dimensions, description of features and date excavated.

- **Any potentially hazardous waste encountered will not be disposed of under this delivery order.** Potentially contaminated soils and other waste materials will be left on the Port-A-Pads or Visqueen sheeting.

- After the above items have been completed, the trench shall be refilled with the materials (uncontaminated) that were previously excavated.

- Backfill, compact and regrade the excavated trench to existing ground level.

- No seeding or reclamation will be performed under this delivery order. The sites will be graded and compacted with a dozer, then left as is. Requirements for final restoration of these disturbed areas will be determined by the USACE in consultation with State and Federal Fish and Wildlife agencies.

- If potentially hazardous materials are encountered, the backhoe will be decontaminated following the segregation of each stockpile of potentially hazardous material. Decontamination of the backhoe will consist of removing the majority of the dirt on the bucket with a shovel, followed by brushing and wet swabbing of the bucket. No

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waste decontamination water will be generated, and all other waste solid and rags will be placed on the Port-A-Pads.

- Move to the next site. If the previous site was the last site of the day, decontaminate the backhoe bucket, secure, and park the backhoe tractor rig for the evening.

- After completion of all work, equipment, surplus materials, rubbish, and debris incidental to work will be removed from the site. All vehicular ruts will be backfilled and regraded to conform with the existing topography. All work specified under this section will be performed by CDM Federal and will be performed to the satisfaction of the contracting officer.

4.4 FIELD SAMPLING

This section details criteria for sample collection, identification of samples, documentation, sample shipping, decontamination, analytical procedures, and handling of investigation derived waste (IDW).

4.4.1 SAMPLE COLLECTION

At the direction of the USACE, CDM Federal will collect subsurface soil/debris samples during excavation. The samples will be handled in accordance with approved procedures. CDM Federal's geologist will be present during all excavation work. The objective is to identify and segregate all potentially hazardous materials and take samples of any suspicious materials. At least one sample will be collected from each anomaly excavated. The following is a summary of the method for collecting a subsurface soil/debris sample from an excavated trench:

- The geologist will field screen all excavated material (from the backhoe bucket) with a portable device, such as a photoionization detector or flame ionization detector.

- Uncontaminated excavated materials will be placed on the ground at a sufficient distance from the excavation.

- Any potentially hazardous material shall be stockpiled by the backhoe on a USACE furnished Port-A-Pad.

- Sampling personnel will never enter the trench after the excavation to obtain a subsurface soil/debris sample.

- The VOC sample will be collected quickly (to minimize the potential for contaminant volatilization) either from the backhoe bucket, or immediately upon dumping the potentially hazardous material on the Port-A-Pad. Each VOC sample will be collected by completely filling the appropriate container using a stainless steel spoon. Following the collection of the VOC sample, the remaining sample material will be composited (homogenized) in a stainless steel mixing bowl using a stainless steel spoon or similar implement. Samples for SVOCs, Pesticides/PCBs, RCRA metals and total petroleum hydrocarbons will be collected from the homogenized material and placed in the appropriate containers using the stainless steel spoon.

- Under certain circumstances, composite samples may be collected. Composite sampling will be conducted at the direction of the USACE site representative. Composite samples will be thoroughly homogenized using a stainless steel bowl and spoon. Samples collected for volatile organic compound analyses will always be collected as grab samples.

- Sample jars will then be immediately labeled and put on ice. The geologist will record all information including any visual indication(s) of contamination or landfill debris in the field logbook.

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4.4.2 SAMPLE IDENTIFICATION

Samples will be identified though the use of a coding system to identify sample locations and type. The coding system will ensure that samples are uniquely identified, and provide a tracking procedure to facilitate data retrieval. Subsurface soil/debris samples will be numbered according to the following system:

- Trench Subsurface Soil/Debris Sample ID

  Sample Number: 94H06L(E)-A01-01-010

94	=	Year designator
H06L(E)	=	H06L East Landfill
A01	=	Anomaly A-1
01	=	Location 1
010	=	Subsurface Sample Depth (feet below ground surface)

In addition to the sample designations described above, each sample must be clearly labeled with a Hanford Environmental Information System (HEIS) number.

4.4.3 SAMPLE LABELING, PACKAGING, AND SHIPPING

This section discusses labeling, packaging, and shipping procedures for samples. Refer to Section 4.7 for information on sample containers and preservatives. The point-of-contact for issues regarding samples is Paul Karas (509-943-5828) or George DeLullo (303-232-0131).

The following information shall be included on sample labels:

- Site name.
- Sample ID number.
- Date and time collected.
- Designation of the sample as grab or composite.
- Type of sample (soil).
- Sampler(s) initials.
- Whether the sample is preserved or unpreserved and the type of preservative used, if any.
- Types of analysis to be conducted.

Sample seals will be placed around the cap of each sample bottle. Sample seals will be dated and initialed by the collector. Each of the sample bottles will be labeled. A typical sample label is shown in Appendix D. Sealed and labeled bottles will be placed inside recloseable clear plastic bags. The sample containers will then be placed in a large plastic garbage bag which is padded with an absorbent material, such as vermiculite. The top of the garbage bag will be sealed with tape, placed in a cooler, and chilled with wet ice contained in recloseable plastic bags. Sample documents (i.e., chain-of-custody) will be affixed to the underside of each cooler lid. The coolers will be labeled for shipment as environmental samples. The cooler lid shall be secured with strapping tape at a minimum of two locations. The drain shall be taped shut. The cooler shall be sealed with two numbered and signed custody seals. "This Side Up" labels shall be placed on all four sides of the cooler, and "Fragile" labels shall be placed on at least two sides. The shipping labels on the coolers will identify the CDM

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Federal point-of-contact and phone number. Shipments to the laboratory will be handled by overnight carrier, such as Federal Express. Samples will usually be shipped on the day after they are collected. Advance coordination and notification will be required for any shipments on Friday (which will arrive at the laboratory on Saturday).

4.4.4 DOCUMENTATION

Documentation consists of all paperwork used to both track the samples through the analytical process and create a permanent record of field activities associated with the sampling effort. All activities at the site will be documented in a designated field logbook. Logbooks will be used to record the specific field information collected for each activity. All logbooks will be bound, hard-cover books, with sequentially numbered water-resistant pages. Ring binders or similar types of binders do not constitute a bound logbook.

The front of the logbook will list the project number and name; the name of the contractor (CDM Federal) performing the field investigation; the client (USACE); and the date(s) of use. Entries will be as descriptive as possible, so that a particular situation can be reconstructed without reliance on the collector's memory. Entries will be made in black indelible ink with no erasures permitted. If an incorrect entry is made, the data will be crossed out with a single mark, initialed, and dated. Each page will be dated and signed by the individual responsible for completing the entry.

4.4.4.1 General Entries

Listed below are the general entries to be made by CDM Federal personnel in the H-06-L Landfill site logbooks:

- Day, date, and time entered site; temperature, weather conditions, and names and titles of personnel present on site;
- Names, titles, and organization(s) of any visitors who entered the site during the day.

- Chain-of-custody details to include air bill, sample chain-of-custody form number, and sample label/tag numbers

- Types of samples and laboratories to which samples were sent, etc.

- Arrival time of any subcontractors on site and the name(s) of subcontracting personnel.

- Specific comments relative to any problem areas that occurred during the day's activities, their final resolution, and their anticipated impact on the outcome of the field investigation.

- Instruments calibrated during the day and the individual who performed the calibration.

- A record of telephone calls (incoming or outgoing) pertaining directly to the decision-making process of the field investigation, along with the outcome of each conversation.

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4.4.4.2 Sampling Entries

The H-06-L Landfill site logbooks will contain the following entries related to sampling activities:

- Sampling activity, weather, field personnel present, and level of personal protection being used on the H-06-L site.

- At each station where a sample is collected or a measurement is made, a detailed description of the location will be noted. Equipment used to collect samples will also be recorded in the logbook, along with the time of sampling, sample description, volume and number of samples, and the date on which the equipment was calibrated, and the decontamination procedure. Sample numbers will be recorded. Duplicate samples, which receive a separate sample number, are also noted. In addition, the container lot numbers will be recorded.

4.4.4.3 Other Documentation

Other forms to be used in documenting the H-06-L Landfill site-investigation activities are described below.

- **Chain-of-Custody Forms:** Chain-of-custody forms will be used to document the handling and processing of all samples from the time of collection until they are destroyed.

All samples will remain in the custody of the CDM Federal sampling personnel during each sampling activity. Prior to the transfer of the samples to the laboratory, chain-of-custody entries will be made using a chain-of-custody form and sample labels. A sample analysis request sheet shall be checked before transferring custody. Upon transfer of custody, the chain-of-custody form will be signed by the site geologist and placed with the other paperwork in a plastic bag taped to the inside of the cooler lid. A signed and dated custody seal will be placed over the lid opening of the cooler. A sample Chain-of-Custody record is shown in Appendix D.

All chain-of-custody forms received by the subcontracting laboratory will be signed and dated by the laboratory's sample custodian. The custodian will note the condition of each sample received as well as observations concerning sample integrity. The custodian will also maintain a sample-tracking record that will follow each sample through all stages of laboratory processing. These records will be used to determine compliance with holding time limits during any laboratory audit and/or data verification.

The chain-of-custody record will contain the following information:

(1) Sample identification number.

(2) Date and time of sample collection.

(3) Type of sample.

(4) Number of containers per sample.

(5) Analysis requested (include EPA method number)

(6) Signature of person involved in the chain of possession.

(7) Inclusive dates of possession.

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(8) Any pertinent comments that may aid the subcontracting laboratory in analyzing the samples.

(9) Condition of the shipping container (cooler) and sample jars/bottles when opened in the laboratory.

- **Chain-of-Custody Seal:** A Chain-of-Custody Seal is used to ensure that samples have not been tampered with during shipment. The seal is filled out by the sampler prior to shipment and placed on the cooler. The seal is broken by the laboratory personnel upon opening the cooler and filling out the cooler receipt form. At least two seals should be placed across the cooler lid (on two opposite sides of the cooler). A typical sample label is shown in Appendix D.

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4.4.5 EQUIPMENT DECONTAMINATION

All reusable equipment used to collect, handle, or measure samples will be decontaminated before coming into contact with any sample. The decontamination procedure will match the degree of contamination on the sampling tool. Decontamination of sampling equipment will occur at portable decontamination stations set up at sampling locations. Decontamination of excavation equipment will occur at Port-a-Pads. All items that will come into contact with potentially contaminated media will be decontaminated prior to use. If decontaminated items (other than the backhoe bucket and shovels) are not immediately used, they will be covered either with plastic or aluminum foil, depending on the size of the item. All decontamination episodes, and the procedures used, will be recorded in the field logbook. The general decontamination procedures for the equipment being used are listed below:

- Decontamination of the backhoe will consist of knocking off the majority of the dirt on the bucket with a shovel, followed by brushing and wet swabbing of the bucket. No decon waste-water will be generated.

- Stainless steel bowls, spoons and other sampling equipment will be cleaned with alconox and tap water, rinsed thoroughly with tap water, rinsed with methanol, rinsed again with tap water, and then rinsed with deionized water. The items will be completely air dried prior to use. Items not immediately used will be either wrapped in aluminum foil (small items) or in sheet plastic (larger items).

- Decon water generated from decontamination of sampling equipment will be containerized. A sample of each container (55 gal max) of decon water will be sampled and analyzed to determine proper disposition.

4.4.6 QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

The field QC samples being sent to the offsite laboratory will include duplicates, equipment rinsates, and trip blanks. QC sample frequency and protocol is discussed in the QAPjP (Appendix A). QA samples will be sent to a USACE QA laboratory. These samples will be collected as field duplicates of environmental samples submitted to CDM Federal's off-site laboratory. The addresses for laboratories to be used during this investigation are:

Analytical Laboratory Subcontracted to CDM Federal:
Environmental Science & Engineering, Inc.
14220 W. Newberry Rd.
Gainesville, FL 32607
(904) 332-3318 Fax: (904) 332-0507

USACE QA Laboratory:
U.S. Army Corps of Engineers
North Pacific Division Laboratory
1401 N.W. Graham Avenue
Troutdale, OR 97060-0503
POC: Pam Hertzberg
(503) 665-4166 Fax: (503) 665-0371

All laboratories will be notified ahead of time if Saturday delivery is required.

QA and QC samples will be prepared in accordance with the procedures in the QAPjP and will be used as a check of laboratory and field sampling procedures. Matrix spike/matrix spike duplicate samples (extra sample volumes) will also be submitted to the CDM Federal offsite lab as described in the QAPjP.

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4.4.7 OFFSITE LABORATORY ANALYSES

Subsurface soil and debris samples collected during this project will be sent to the subcontract offsite laboratory (ESE). The analyses to be performed and data packages provided by the offsite laboratory will reflect EPA Quality Level III, except for 10% "CLP-type" analyses which will reflect EPA Quality Level IV. Table 4-1 presents analytical parameters, container and preservative requirements, and maximum holding times for each matrix to be sampled.

4.4.8 INVESTIGATION DERIVED WASTE PLAN

All potential hazardous materials shall be stockpiled at a staging area (adjacent to the excavation) consisting of USACE furnished Port-A-Pads (30 mil thick PVC sheets) measuring approximately 8 feet by 27 feet in size or on "Visqueen" sheeting. Incidental investigation derived wastes (e.g., personal protective equipment), generated during field sampling activities, will be placed into drums and left on the PVC liners. Decontamination fluids generated from decontamination of sampling equipment will be containerized. These fluids will be sampled to determine appropriate disposal at the end of the project, or when the container (55 gal maximum) is filled. Final waste disposition will be determined based on procedures outlined in a project-specific waste control plan developed by USACE. Handling, labeling, transportation, treatment and/or disposal will be accomplished in an environmentally protective manner and in compliance with applicable federal, state, and Hanford site requirements.

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TABLE 4-1

ANALYTICAL METHODS, CONTAINERS, PRESERVATIVES, AND HOLDING TIMES

MATRIX	PARAMETER[1]	CONTAINER	PRESERVATIVE	HOLDING TIME (Extract/Analysis)
Soil/Debris	Volatile Organic Compounds (8260)	2 x 40 ml glass	ice to 4°C	14 days
	Semi-Volatile Organic Compounds (8270)[2]	1 x 8oz glass	ice to 4°C	7 days/40 days
	Pesticides/PCBs (8080)	1 x 8oz glass	ice to 4°C	7 days/40 days
	8 RCRA Metals[3] (6010/7000)	1 x 8oz glass	ice to 4°C	6 months
	Total Petroleum Hydrocarbons (418.1W)[4]	1 x 8oz glass	ice to 4°C	28 days
Water	Volatile Organic Compounds (8260)	2 x 40ml glass vial	HCl, pH<20 ice to 4°C	14 days
	Semi-Volatile Organic Compounds (8270)	2 x 1 l amber glass	ice to 4°C	7 days/40 days
	Pesticides/PCBs (8080)	2 x 1 l amber glass	ice to 4°C	7 days/40 days
	8 RCRA Metals (6010/7000)	1 x 1 l poly	$HNO_3$to pH<2.0 ice to 4°C	6 months
	Total Petroleum Hydrocarbons	1 x 1 l glass	H_2SO_4 to pH<2.0 ice to 4°C	28 days

1 EPA SW-846 Method Numbers unless otherwise indicated
2 Will include identification of 10 highest concentration tenatively identified compounds (TICs)
3 As, Ba, Cd, Cr, Pb, Hg, Se, Ag
4 Washington State Modified Method

5.0 REFERENCES

CDM Federal, January 1993, Quality Assurance Manual, Parts One and Two, CDM Federal, Fairfax, Virginia

Westinghouse Hanford Company, 1990, North Slope Investigation Report, WHC-EP-0359, Westinghouse Hanford Company, Richland, Washington.

Westinghouse Hanford Company, 1992, Geophysical Surveys of Military Landfills Located on Hanford's Wahluke (North) Slope, WHC-50-EN-ER-001, Rev. O, Westinghouse Hanford Company, Richland, Washington.

United States Department of Energy, 1994, North Slope Expedited Response Action Proposal, DOE/RL-93-47, Rev. O, United States Department of Energy, Richland, Washington.

United States Geological Survey, 7.5 - Minute Topographic Quadrangle Maps of Washington: Locke Island 1986, Corfu 1986.

Washington State Department of Ecology, 1994, Action Memorandum: North Slope (Wahluke Slope) Expedited Response Action Cleanup Plan, U.S. Department of Energy Hanford Site, Richland, WA; to Mr. Ron Izatt, USDOE, from Drusilla Butler, Washington State Department of Ecology and Randall F. Smith, USEPA.

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Appendix A

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APPENDIX A

QUALITY ASSURANCE PROJECT PLAN

LANDFILL CHARACTERIZATION AND REMEDIATION
SITE H-06-L
HANFORD NORTH SLOPE, WASHINGTON

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MISCELLANEOUS ARCHITECT ENGINEER SERVICES FOR HAZARDOUS, TOXIC, AND RADIOLOGICAL WASTE (HTRW) PROJECTS FOR U.S. ARMY CORPS OF ENGINEERS WALLA WALLA DISTRICT

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QUALITY ASSURANCE PROJECT PLAN

LANDFILL CHARACTERIZATIONAND REMEDIATION
SITE H-06-L
HANFORD NORTH SLOPE, WASHINGTON

CONTRACT NO. DACW68-94-D-001

Approved by: _____ Date: APRIL 7, 1994
Paul Karas
Project Manager

Approved by: _____ Date: April 7, 1994
for Rosemary Ellersick
CDM Federal QA Director

Approved by: _____ Date: APRIL 7, 1994
FOR Charles J. Schick, P.E.
Program Manager

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CEQAPP 1.1 REQUIREMENT LOCATOR

Quality Assurance (QA) requirements established in the U. S. Army Corps of Engineers (USACE) Quality Assurance Program Plan (CEQAPP) 1.1 Revision 2 dated June 15, 1993 and in the U.S. Environmental Protection Agency (EPA) Quality Assurance Management Staff (QAMS) interim guidelines and specifications for preparing Quality Assurance Project Plans are relevant to this project. This locator section indicates the appropriate portions of this plan and the supporting documents which address each of the sixteen elements described in CEQAPP 1.1 and in QAMS 005/80.

CEQAPP 1.1 AND QAMS 005/80 REQUIREMENT	LANDFILL CHARACTERIZATION AND REMEDIATION, SITE H-06-L
• Title /Title Page With Approval Signatures	Title Page/Approval Page
• Table of Contents	Table of Contents
• Project Description	Section 2.0
• Project Organization & Responsibility	Section 3.0
• QA Objectives	Section 5.0
• Sampling Procedures	Section 6.0
• Sample Custody	Section 7.0
• Calibration Procedures & Frequency	Section 8.0
• Analytical Procedures	Section 9.0
• Data Reduction, Validation, and Reporting	Section 10.0
• Internal Quality Control Checks	Section 11.0
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• Preventive Maintenance	Section 8.0
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LIST OF ABBREVIATIONS AND ACRONYMS

AA	Atomic Absorption
bgs	below ground surface
CDM Federal	CDM Federal Programs Corporation
CLP	Contract Laboratory Program
COC	Chain-of-custody
CV	Cold Vapor
DOE	U.S. Department of Energy
DQCR	Daily Quality Control Report
DQOs	Data Quality Objectives
EPA	U.S. Environmental Protection Agency
ERA	Expedited Response Action
ESE	Environmental Science and Engineering, Inc.
FID	Flame-ionization Detector
FSP	Field Sampling Plan
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
ICP	Inductively Coupled Plasma
IRFNA	Inhibited Red-Fuming Nitric Acid
MS/MSD	Matrix Spike/Matrix Spike Duplicate
OVA	Organic Vapor Analyzer
OVM	Organic Vapor Monitor
PARCC	Precision, Accuracy, Representativeness, Comparability and Completeness
PCBs	Polychlorinated Biphenyls
PID	Photoionization Detector
PPM	Parts per Million
QA/QC	Quality Assurance/Quality Control
QAPjP	Quality Assurance Project Plan
QAMS	Quality Assurance Management Staff

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RPD	Relative percent difference
RSD	Relative standard deviation
SOP	Standard Operating Procedure
SOW	Statement of Work
TPA	Tri-Party Agreement
TRPH	Total Recoverable Petroleum Hydrocarbons
USACE	U.S. Army Corps of Engineers
µg/kg	microgram(s) per kilogram
VOA	Volatile organic analysis
VOC	Volatile organic compound
WHC	Westinghouse Hanford Company

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1.0 INTRODUCTION

CDM Federal Programs Corporation (CDM Federal) has prepared this Quality Assurance Project Plan (QAPjP), for the U.S. Army Corps of Engineers (USACE) Walla Walla District under Contract No. DACW68-94-D-0001. This QAPjP governs activities being conducted as part of a landfill characterization and remediation at Site H-06-L located on the Hanford North (Wahluke) Slope, Washington. This characterization and remediation is being conducted as a continuation of investigations initiated by the Westinghouse Hanford Company (WHC) in 1990 and 1992 to determine the total extent of buried wastes and potential waste types at this site. This QAPjP presents the organizational structure and policies, functional activities, and specific quality assurance (QA) and quality control (QC) activities designed to achieve the project goals and objectives. The field sampling activities presented in this QAPjP are described in more detail in the Work Plan for Site H-06-L. QA/QC activities presented in this QAPjP were developed in accordance with requirements in the USACE Statement of Work (SOW) dated February 7, 1994 and subsequent modifications.

Quality assurance is defined as the integrated program designed for assuring reliability of monitoring and measurement data. QA procedures are implemented, as necessary, to ensure that all project work is performed in accordance with professional standards and USACE, U.S. Environment Protection Agency (EPA), and other applicable governmental requirements and guidelines. Quality control is defined as the routine application of procedures for obtaining prescribed standards of performance in the monitoring and measuring process. All personnel generating data have the responsibility to implement procedures that assure that the precision, accuracy, representativeness, comparability, and completeness of generated data are known and documented. In addition, the data quality levels (i.e. EPA Levels I, II, III, etc.) established should be consistent with the anticipated uses of the data and the project objectives. This QAPjP has been prepared to ensure that this responsibility is met uniformly throughout the duration of this project.

The following sections of the QAPjP include a discussion of project objectives and site background information; project organization and responsibility; document control; QA

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objectives for measurement data; proposed sampling activities and procedures; sample custody requirements; equipment operation, maintenance, calibration, and standardization procedures; analytical laboratory procedures; data quality management; QC checks and samples; and QA oversight.

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2.0 PROJECT DESCRIPTION

2.1 BACKGROUND

The H-06-L Landfill site is one of several former military sites on the Hanford North Slope which must be investigated for possible environmental hazards prior to excising the property from U. S. Department of Energy (DOE) control. A variety of remedial alternatives for the North Slope were presented in an expedited response action (ERA) proposal developed by DOE in 1993. This ERA proposal describes each of the North Slope sites and identifies a preferred alternative which utilizes the "observational approach" (i.e. concurrent characterization and remediation). The Washington State Department of Ecology, lead regulatory agency for the North Slope ERA, concurred with the preferred alternative and provided formal approval in an Action Memorandum in 1994. This action supports Milestone M-16-82 of the Hanford Tri-Party Agreement (TPA) between DOE, EPA, and the State of Washington.

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The work proposed in the Work Plan for the H-06-L Landfill site constitutes the second step in implementation of the remedial alternative approved by the State. The first step of the remedy, minimization of physical hazards, is essentially complete. Data generated during the current effort will help define the scope of work necessary to characterize, and if required, remediate the remaining Hanford North Slope landfills, to complete the remedy.

2.2 PROJECT OBJECTIVES AND SCOPE

The landfill characterization and remediation activities for Site H-06-L include preparing planning documents, implementing a field program, and preparing data reports. These proposed activities were developed from the USACE SOW (February, 1994). The objectives of the investigation are to determine if any hazardous materials are present in disposal cells at the H-06-L Landfill, and if so, to characterize and segregate these materials for proper disposal. Accomplishment of these objectives will reduce future risks to human health and

the environment and provide data to plan the level of characterization and remediation necessary at other North Slope sites. These objectives will be accomplished through the excavation of buried wastes, segregation of potentially hazardous materials using visual evidence and field screening techniques, and laboratory analyses of debris and soil samples. Specific sampling data quality objectives (DQOs), are summarized in Section 5.0 of this QAPjP.

2.3 SITE LOCATION, DESCRIPTION, AND HISTORY

The H-06-L site is located in Grant County, Washington, in Section 34 of Township 15 North, Range 27 East (Figure 2-1). The site is divided into east and west areas by the White Bluffs Wasteway and unimproved road that intersects with State Highway 24 approximately 300 feet of the site (Figure 2-2). The site is about 20 acres in size and contains approximately 8 acres of burial trenches.

The H-06-L site is located in an area known as the North Slope of the Hanford Reservation. The North Slope consists of approximately 140 square miles of land north of the Columbia River across from the active area of the Hanford Reservation. The North Slope was homesteaded from the late 1800s until the government took control of this area in the early 1940s. Prior to government control of the North Slope, homesteaders used the land primarily for grazing sheep and cattle and growing row crops and orchards. Wheat was grown on high ground away from the river. Grazing took place on land too arid or too distant from water for crops.

Additional land acquisitions took place in the 1950s for construction of the Nike Missile Air Defense System and anti-aircraft emplacements a well as to increase the buffer zone from the public lands and the production areas of the reservation. There were a total of seven antiaircraft gun emplacements and three Nike missile positions located on the North Slope. These military sites were closed down in the early 1960s. Many of the military buildings were considered a potential hazard to the public and were torn down or decommissioned in

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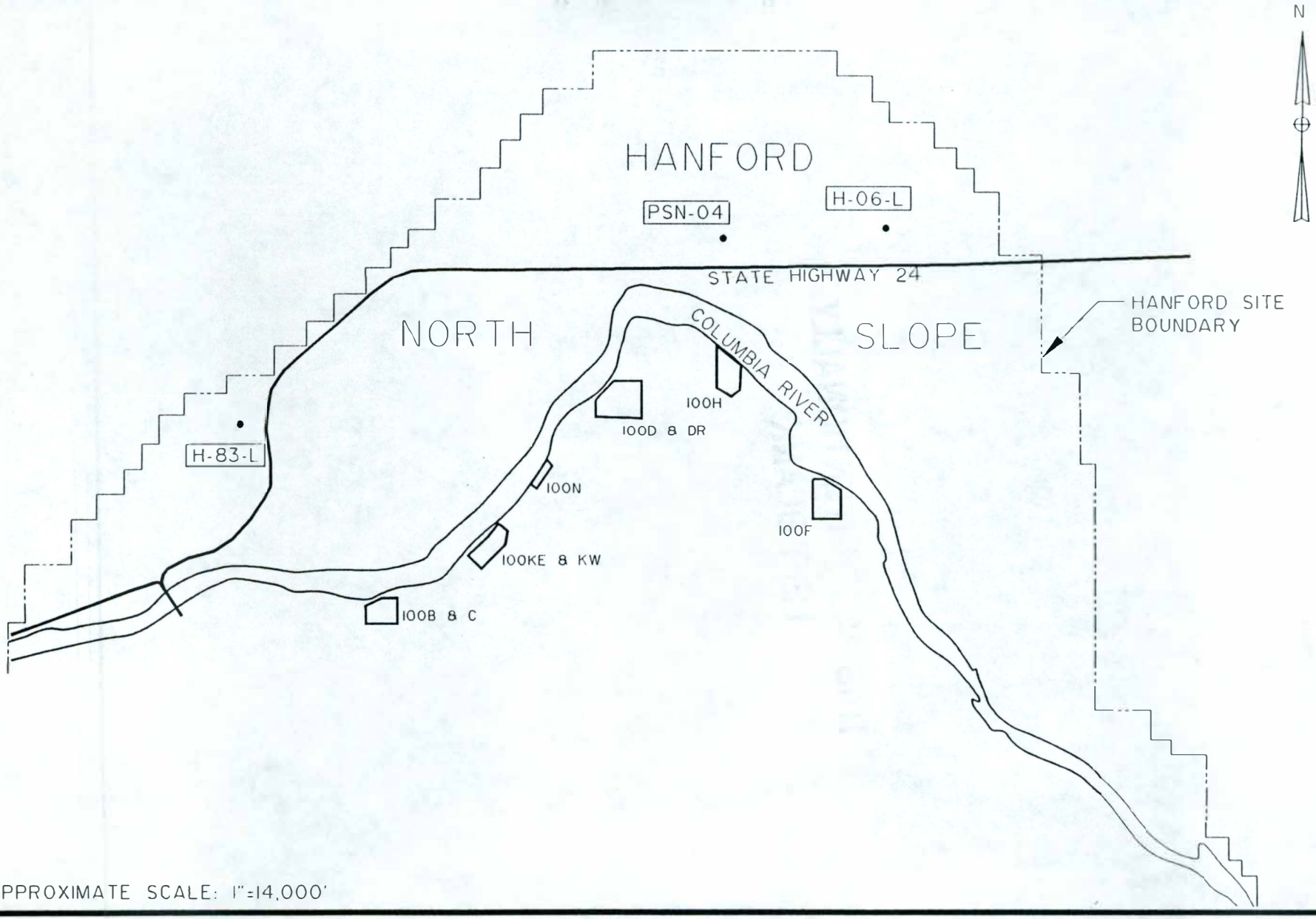

Site Location Map
Hanford North Slope, Washington

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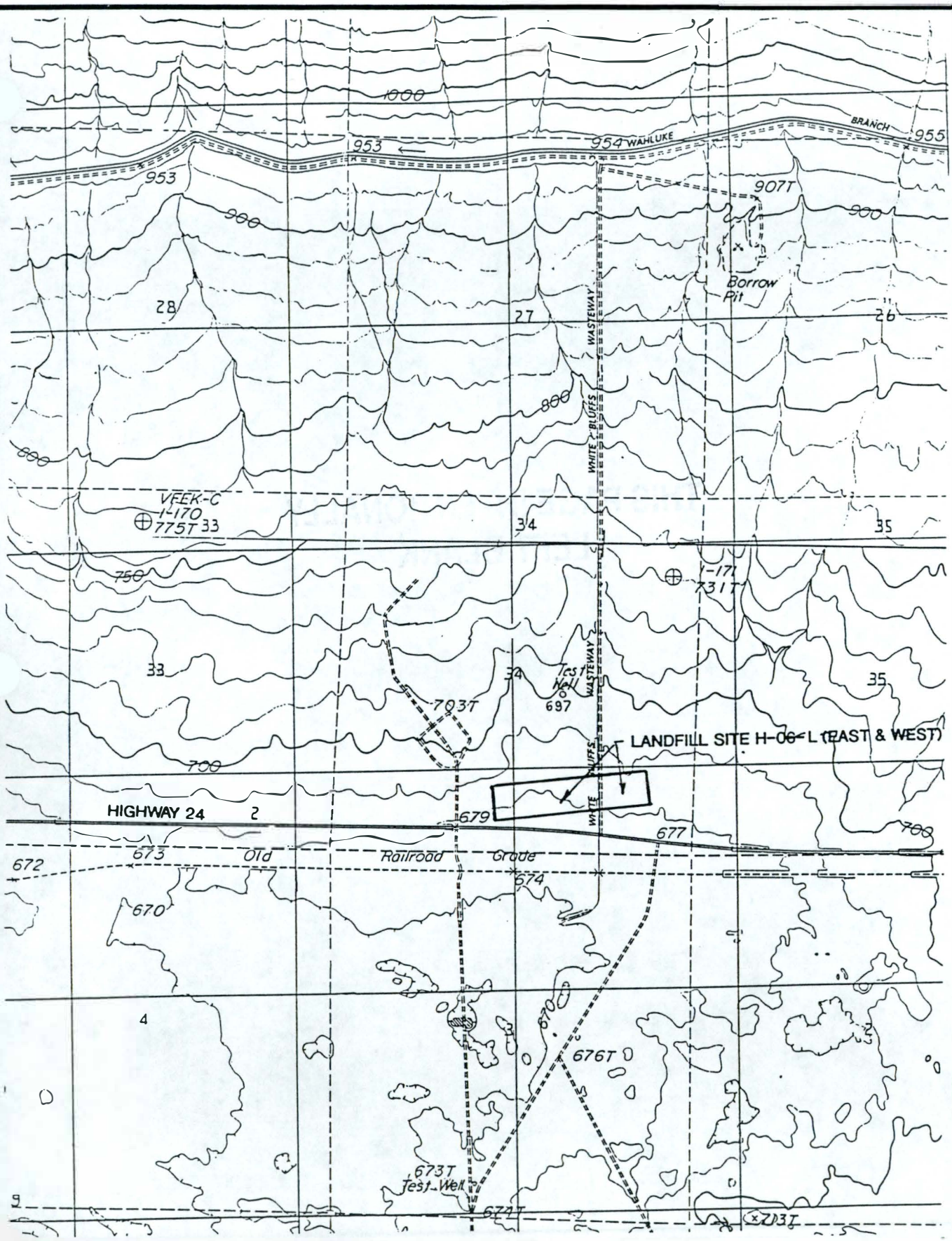

LOCATION OF LANDFILL SITE
H-06-L (EAST AND WEST)

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the mid 1970s. Evidence remains of the existence of many of these buildings. The area has not had any active military installations on it since this period; however, the area has been used for military training maneuvers.

There are at least 10 landfills (including H-06-L East and West) associated with the former military installations on the North Slope. The specific contents of the military landfills are unknown. It is probable, based on debris scattered on the surface, that domestic trash and demolition debris were disposed of at these sites. It is possible that the missile sites may have contributed small quantities of hazardous constituents. Operational information indicates Jet fuel, inhibited red-fuming nitric acid (IRFNA), aniline, hydrazine, and trichloroethylene were used in support of missile operations. Interviews with former military personnel assigned to the area indicate that these substances were used conservatively and were not normally available in large quantities. Limited vehicle maintenance activities may have contributed used motor oil to the landfills. Demolition wastes likely include asbestos-based materials such as transite (WHC 1990).

With the recent change in mission at Hanford from plutonium production to environmental cleanup, attention has been given to releasing relatively clean tracts of land for other uses. Since 1975, the area has been permitted to the Washington Department of Wildlife and the U.S. Fish and Wildlife Service. Some areas have been open to the public. Certain areas included in the wildlife management area have been opened for cattle grazing to ranchers who obtain grazing agreements. Some areas are currently being grazed. The eastern portion of the land contains a wasteway which bisects the H-06-L site and is used to rid local farms of runoff.

2.4 SUMMARY OF PREVIOUS INVESTIGATIONS

The information presented in this section was obtained from the following documents:

- WHC, 1990, North Slope Investigation Report, WHC-EP-0359, Westinghouse Hanford Company, Richland, Washington.

- WHC, 1992, Geophysical Surveys of Military Landfills Located on Hanford's Wahluke (North) Slope, WHC-SD-EN-ER-001, Rev. O, Westinghouse Hanford Company, Richland, Washington.

- US DOE, 1993, North Slope Expedited Response Action Proposal, United States Department of Energy, Richland, Washington.

Two previous investigations were conducted at the H-06-L Landfill Site by WHC. The first, conducted in 1990, involved an investigation of the North Slope area to assess potential health, safety, and environmental concerns raised by the DOE, the Washington Department of Ecology, and the public. The second investigation was conducted in 1992, also by WHC, and involved performing geophysical and subsurface soil sampling investigations. The following paragraphs summarize the work performed.

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2.4.1 1990 North Slope Investigation

In 1990, WHC conducted an investigation of the North Slope area. As a result of this investigation, thirty-nine sites posing potential hazards were identified on the North Slope. These sites were associated with either military or homesteading activities. Ten of the thirty-nine sites identified from this investigation are landfills associated with the former military installations on the North Slope including the Nike/antiaircraft Landfill. Reconnaissance of the H-06-L Landfill Site indicated apparent soil disturbance and surface debris including paint cans, construction materials, asbestos-based materials (transite), and an asbestos brake pad.

2.4.2 1992 North Slope Investigation

Geophysical surveys were conducted at three sites (PSN-04, H-06-L and H-83-L) on Hanford's North Slope, from July 27 through August 4, 1992. The purpose of the geophysical surveys was to characterize waste disposal practices at the three sites and to

locate areas requiring further environmental investigation. To meet these objectives, magnetic and electromagnetic induction surveys were conducted in two areas totaling 20.9 acres at site H-06-L. The survey areas were determined based on surface characteristics such as stressed vegetation, subsidence, and surface and partially buried debris. The results of these surveys are documented in WHC 1992.

Areas where geophysical surveys indicated trenches and disposal sites were staked and marked. The surface of these areas were evaluated for signs of subsidence/stressed vegetation and presence of partially buried debris. Subsurface soil sampling locations were selected as close as possible to the center of the more significant anomalies and near areas of subsidence or stressed vegetation.

A hollow-stem auger rig was used to obtain the subsurface soil samples. Cuttings from the auger were screened for organic vapors at 2-foot intervals using an organic vapor monitor (OVM). Debris associated with the cuttings included wood, metal drums and cans, and transit.

Field screening was used to determine the scope of sampling at each location. Screening samples were taken at approximately the 6- and 10-foot levels (bottom of the landfill was estimated to be 9 to 11 feet). At least one sample was collected from each anomaly drilled for analysis at an offsite laboratory.

Field screening analyses included pH, heavy metals, and volatile organic compounds depending on sample characteristics (i.e., color and OVM readings). Offsite laboratory analyses included volatiles and semi-volatiles, pesticides/herbicides, polychlorinated biphenyls (PCBs), inductively coupled plasma (ICP) and atomic absorption (AA) analyses for metals (including mercury), anions, chromium VI, total petroleum hydrocarbons, and total activity (radioactivity). A total of 36 samples from 45 auguring locations were taken from the three landfills for analysis at offsite laboratories. This included six samples from Nike position H-83-L, 16 from Nike position H-06-L, eight from anti-aircraft position PSN-04, and six QA/QC

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samples. A total of 90 field screening samples were collected during this effort (two per auger boring). Samples collected and analyzed during this investigation indicated that no hazardous materials other than non-friable asbestos-containing materials were present.

2.5 CONCEPTUAL MODEL

Site investigations and sampling (WHC 1992) supported the conclusions reached earlier (WHC 1990) based on records review and interviews that little or no hazardous material was disposed in the H-06-L site. Primary constituents in the disposal trenches and pits are probably construction debris, residential and office trash, scrap metal, paint and oil cans, and other non-hazardous materials. Some construction materials disposed at the site contained asbestos (e.g., transite); however, it is expected that this asbestos-containing material is almost exclusively non-friable and therefore, non-regulated. Some minor quantities of liquid paints, oils, or solvents may have been disposed also. Most of these fluids are expected to have been absorbed by landfill debris and soils and may be significantly degraded. A neutralization pit for acids from the Nike site has never been identified. This pit may be located during excavation. There is a small potential for ordnance (small arms or anti-aircraft artillery ammunition duds) to be present in the landfills.

Wastes are present in small to large pits, elongate trenches, and possibly in small isolated burial locations. Cover materials are expected to range from 0 to 5 feet thick with maximum depth of burial anticipated to be about 9 to 11 feet. The largest known disposal feature is anomaly A-11 in H-06-L East. This disposal trench may be as long as 325 feet.

There is no evidence for disposal at H-06-L of large quantities of liquid wastes. Therefore it is assumed that subsurface migration of waste constituents has been minimal. During the investigation, disposal features will be excavated until all stained and suspect contaminated materials have been removed, subject to the limitations of the excavation equipment. If contamination continues beyond the depth which on-site equipment can excavate, the depth

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reached will be documented and additional investigation postponed pending analytical laboratory results from samples collected at that depth.

2.6 PROJECT SCHEDULE

The project schedule for the landfill characterization and remediation at site H-06-L anticipates a start date of April 18, 1994 for field activities, and a final report completion date of June 17, 1994. A more detailed project schedule is presented in the Work Plan.

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3.0 PROJECT ORGANIZATION AND RESPONSIBILITY

3.1 MANAGEMENT ORGANIZATION

CDM Federal's project management organization for this project is presented in Figure 3-1. Figure 3-2 illustrates the organization and interfaces for Washington Department of Ecology, EPA, DOE, USACE, CDM Federal and subcontractors for field activities at the H-06-L site.

The CDM Federal Project Manager, Mr. Paul Karas, is responsible for the day-to-day management and coordination of project activities. His specific responsibilities include:

- Overseeing the execution of the project and coordinating and implementing directives from the USACE.
- Coordinating all planning work, field work, and data reporting work performed as part of the landfill characterization and remediation for site H-06-L with the USACE.
- Maintaining a record of all pertinent discussions related to the execution of the landfill characterization and remediation. This record will be entitled "Confirmation Notices." Each entry will be assigned a number, and a copy of the Confirmation Notices will be supplied to the USACE every month.
- Developing and updating (weekly) a schedule of the landfill characterization and remediation. The weekly update will include changes and delays to the existing schedule, as well as rationale for the schedule modifications.
- Preparation, review, and approval of deliverables, including the QAPjP, the Work Plan and the Technical Report.
- Implementing QC procedures specified in the Work Plan, QAPjP, and other project documents.
- Managing subcontractor efforts for field support activities, and coordinating laboratory needs for this task.
- Identifying and implementing necessary corrective actions.

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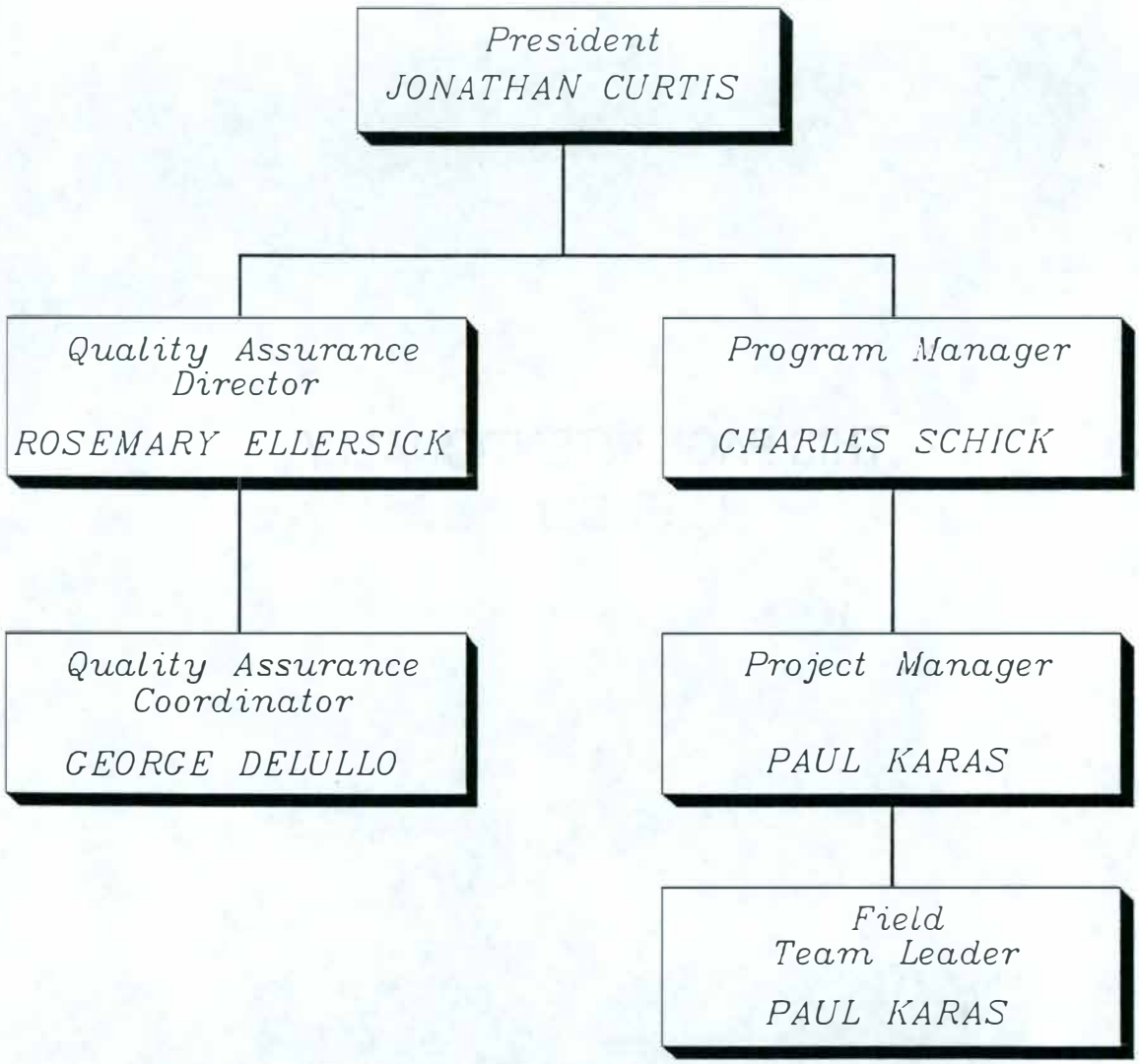

CDM FEDERAL PROJECT ORGANIZATION

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LANDFILL H-06-L
HANDFORD NORTH SLOPE

Project No:
5110-001

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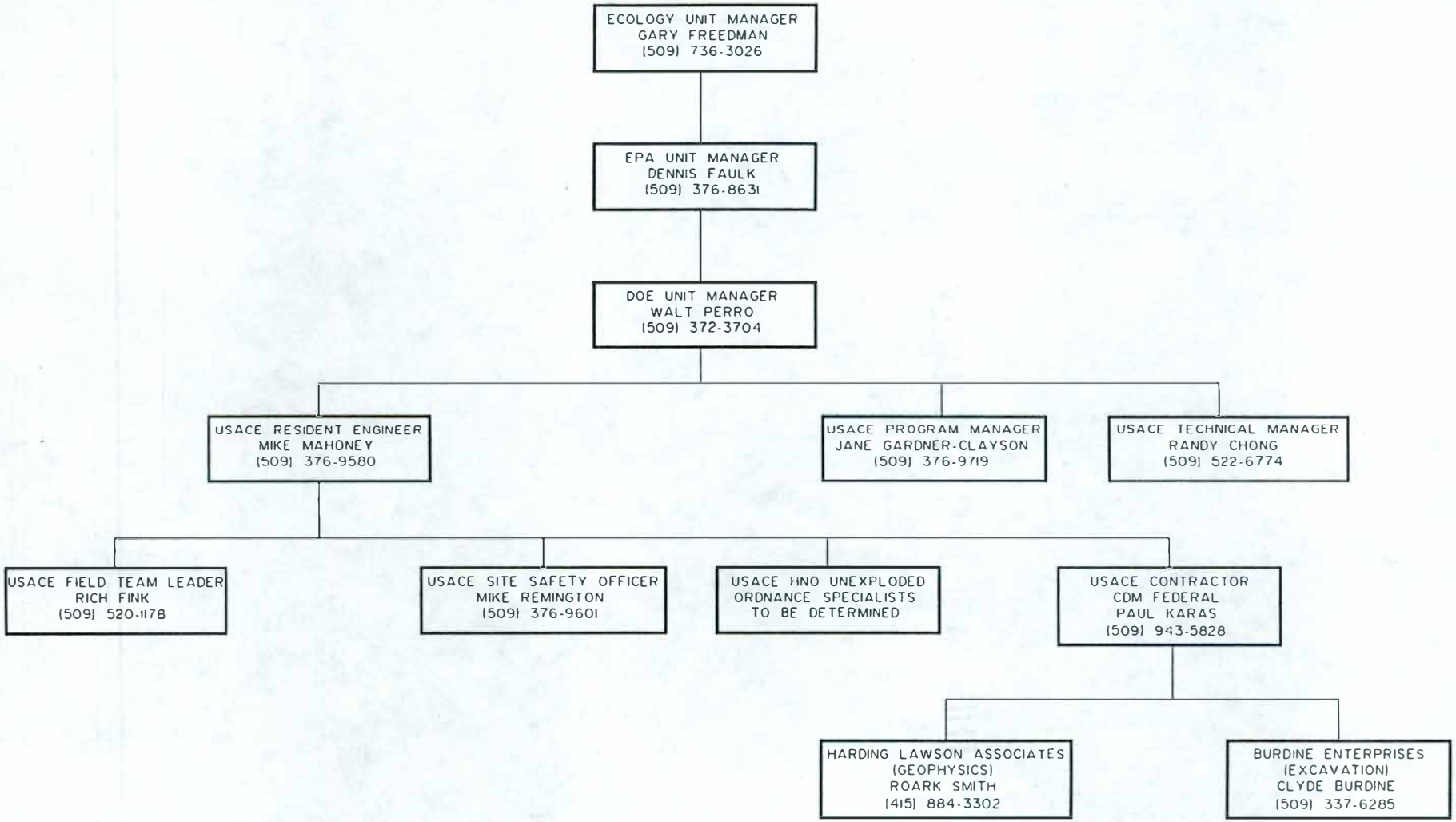

II-06-L LANDFILL FIELD ACTIVITIES ORGANIZATION CHART

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As Project Manager, Mr. Karas will also serve the role of Site Manager, as identified in the SOPs included with the Work Plan. Finally, Mr. Karas will also function as the Site Safety and Health Officer and Field Team Leader.

The Field Team Leader is responsible for overseeing field operations. Specific responsibilities include:

- Implementing the field aspects of the Work Plan, QAPjP, and other project documents.
- Ensuring that all necessary information is recorded in the field logbooks.
- Communicating with the Project or Program Manager regarding resource and scheduling considerations.
- Implementing the QC measures specified in this QAPjP.
- Notifying the Project or Program Manager of significant field changes to the Work Plan, QAPjP, or other task documents on a daily basis.
- Notifying the CDM Federal QA Director immediately of significant problems affecting the quality of data or the ability to meet project objectives.
- Notifying the subcontractor laboratory of scheduled sample shipments.

Project personnel will be adequately trained and will have the appropriate experience for the positions to which they are appointed. All site personnel will have the required health and safety training, as specified in the Site Safety and Health Plan. The Project Manager will consult with the USACE to ensure that all site personnel receive the required Hanford site-specific training.

3.2 QUALITY ASSURANCE ORGANIZATION

The QA Program is implemented by the CDM Federal corporate QA Director, R.M. Ellersick. The CDM Federal corporate QA Director is independent of the technical staff and reports to

the Chairman of CDM Federal on QA matters. The QA Director thus has the authority to objectively review projects and identify problems, and the authority to bring corporate resources to bear in solving problems, if necessary. The QA Director is responsible for directing the overall QA program for the project. George DeLullo will serve as regional QA coordinator for this project. He will report to the CDM Federal corporate QA Director on quality matters. The CDM Federal QA organization for this project is shown in Figure 3-1.

The CDM Federal QA Coordinator is responsible for:

- Reviewing and approving the QAPjP and Work Plan.
- Maintaining QA oversight for the project.
- Reviewing QA sections in task reports.
- Reviewing QA/QC procedures applicable to this investigation.
- Auditing selected field and reporting activities performed by CDM Federal and subcontractors.

3.3 SUBCONTRACTORS

During the landfill characterization and remediation subcontractors will be used to assist in the implementation of sampling activities. These subcontractors include the excavation subcontractor, geophysics subcontractor, and the offsite analytical laboratory. Subcontractors report directly to the CDM Federal Project Manager.

4.0 DOCUMENT AND RECORDS CONTROL

Document and Records Control requirements have been established in order to ensure that:

- Documents and revisions are distributed and released in a controlled manner and in accordance with USACE policy and contract requirements.
- Documents and records are kept secure, under custody where necessary, without unauthorized reproduction and/or alteration, to provide for physical accountability.
- Records are properly archived at the end of the project.

Control of document distribution and release will be maintained throughout the project. A project file will be maintained in the Richland, Washington office of CDM Federal. A record of distribution (date, individual, affiliation, document title, and revision) will be maintained by the project manager. Additional copying and distribution will not be performed without the authorization of the USACE and the CDM Federal Project Manager with the exception of internal distribution copies. Under no circumstances will any documents be released to the public without USACE, Office of Counsel approval.

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5.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

The overall QA objective for measurement data is to ensure that data of documented quality, acceptable for specified uses, are generated. QA objectives for measurement data are usually expressed in terms of precision, accuracy, representativeness, completeness and comparability. In general, data collected should be:

- Representative of actual site physical and chemical conditions.
- Comparable to previous and subsequent data and other studies.
- Complete to the extent that necessary conclusions may be reached.
- Of known quantitative statistical significance in terms of precision and accuracy, at levels appropriate for each stated data use for the project.

The following sections present information related to project and specific sampling data quality objectives; anticipated data uses and associated levels of data quality, and QA objectives.

5.1 DATA QUALITY OBJECTIVES

5.1.1 GENERAL

Data quality objectives (DQOs) are qualitative and quantitative criteria used to establish requirements for sample collection and analysis, and are based on the needs and intended uses of the data. The overall intent of DQOs is to ensure that data of appropriate type and quality are collected to support the decision-making process for a site. DQOs also establish QC limits for activities involving measurement, and they direct the level of QC performed during field activities.

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For this landfill characterization and remediation, the environmental medium of concern is subsurface soil and debris. This media will be sampled and analyzed to provide the necessary data to meet the objectives of the landfill characterization and remediation.

The purpose of the landfill characterization and remediation is to investigate several landfill trenches at the H-06-L Landfill in order to characterize and segregate potentially hazardous materials for proper disposal. Analytical data will be collected to verify the presence or absence of soil contamination determined in previous investigations and to determine the extent of the landfill trenches and the types of wastes in the trenches. Specific sampling objectives are to:

- Provide geophysical data to determine the extent of the landfill trenches (east and west).
- Provide field screening data which can be used to segregate all potentially hazardous material.
- Provide analytical data to support the presence or absence of subsurface soil contamination at previously identified geophysical anomalies.

The primary data users for data collected during this investigation will include USACE technical and project management staff and the DOE. Additional data users include personnel from EPA and the Washington Department of Ecology. Data will be used to evaluate options for the future disposition of the site including whether the site meets criteria for unrestricted use.

5.1.2 Geophysical Survey Data Quality Objectives

The targets for the geophysical survey, as described in the Statement of Work, are backfilled disposal pits and/or trenches believed to contain site demolition debris including reinforcing steel, cable, conduit, electrical wire, and steel pipe. Such buried metal objects can be readily detected by electromagnetic (EM) and Magnetic (MAG) methods. In addition, non-metallic objects can often be detected with electromagnetic methods. Detection entails measuring

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electromagnetic and magnetic responses in a clean native area to establish baseline background readings, and then performing the geophysical survey to look for anomalous readings above or below the established background values. Experiments by Geonics Limited, the manufacturer of the EM31-D electromagnetic survey instrument, have indicated that a single 45-gallon oil drum will produce a sufficient anomalous response so as to be detectable to a depth of approximately 10 feet. The magnetometer applications manual published by EG&G, Geometrics, Inc., the manufacturer of the G-856 magnetometer, states that 100 pounds of iron will produce an anomalous variation from background of approximately 100 gammas (a measure of magnetic strength) at a distance of 10 foot geophysical survey transects spacing is sufficient to detect burial pits and any localized metal debris between the transects.

As background readings can very significantly between sites, and even with time, the identification of geophysical anomalies is in large part an interpretive process that relies on the geophysicists' experience and knowledge of the specific targets in the search area. EM response is influenced primarily by soil type and moisture content; background magnetic strength depends the latitude of the site, time of day, sunspot activity, as well as the mineral content of the soil and bedrock. Geophysical anomalies are characterized by relative changes in response and not measured against an universal standard.

Data quality is assessed real-time by the geophysicist performing the survey; it is primarily dependant on instrument functionality. To assure functionality, a local calibration point is established for each site. This point is marked in the field and recorded on the site maps. It is visited at the beginning and end of each days' surveying for instrument calibration and tuning. The local background readings are recorded in the geophysicists' field log. Significant variations in the background readings will require the geophysicist to suspend surveying until the cause is determined. If necessary, a replacement instrument will be used. In general, the EM readings obtained at the calibration point will be identical during the course of the survey. Magnetic strength in the mid latitudes is approximately 50,000 gammas, and MAG readings can vary by as much as 50 gammas during the course of a day.

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This variation occurs gradually over several hours; it is recorded by a second base station magnetometer and is removed during data processing. Moreover, MAG anomalies produced by buried metal are typically of 100 gammas or more and are easily identified. It is believed that the above procedures, and those outlined in the Survey Procedures section of the Work Plan, when performed by an experienced field geophysicist, will provide the proper type, quality, and quantity of data to locate backfilled disposal pits and other subsurface debris in the survey areas.

5.2 APPROPRIATE ANALYTICAL LEVELS

Field and analytical data can be used for a number of purposes ranging from determination of the presence or absence of a potential contaminant to precise quantification of concentrations for comparison to regulatory standards or health-based criteria. To ensure that data will be usable for the intended purposes, analytical levels have been established which define data uses and limitations for field and laboratory data. This section defines analytical levels and indicates the levels appropriate to different data uses for the landfill characterization and remediation.

Data quality has been defined by the EPA in terms of five levels of analytical quality control. The landfill characterization and remediation sampling will involve the use of EPA quality Levels I, III, and IV. These levels are described below.

- **Level I:** Field screening data collected with portable field instruments (such as photo-ionization detectors [PIDs], pH meters, etc.) are considered to be Level I data. These data are used to identify the presence of a target compound or group of compounds, without actually identifying or quantifying the specific compound. Level I is commonly used for health and safety monitoring purposes, but can also be sued to identify media or samples to be subject to higher level analyses. During this sampling event, Level I data will consist of PID and/or flame ionization detector (FID) readings collected during health and safety monitoring and sample screening during excavation/trenching operations and subsurface soil sampling.

- **Level II:** Data at this level are generally obtained from field laboratories and may be sufficient for characterizing whether bulk contamination is present, determining which samples will be selected for offsite analysis, and placement of additional sampling locations. Level II data will not be collected during this investigation.

- **Level III:** Comprises all analyses performed at an off-site analytical laboratory. Level III analyses may or may not use Contract Laboratory Program (CLP) procedures, but are minimally required to use EPA-approved methods. They do not usually utilize the validation or documentation procedures required of CLP Level IV analysis. During this sampling event, subsurface soil samples sent to the off-site laboratory will be analyzed (using EPA SW-846 Methods) at EPA Quality Level III.

- **Level IV:** CLP routine analytical services generate data of Level IV quality. All analyses are performed at an off-site CLP approved laboratory following CLP protocols. Level IV is characterized by rigorous QA/QC protocols and documentation. During this sampling event, 10-percent of all subsurface soils samples sent to the off-site laboratory will be analyzed and validated using EPA CLP protocols at EPA Quality Level IV.

- **Level V:** Data at this level are obtained using non-standard methods and analyses which may require method modification and/or development. CLP Special Analytical Services (SAS) are considered Level V. Level V data will not be collected during this investigation.

5.3 OBJECTIVES FOR PRECISION, ACCURACY, COMPLETENESS, REPRESENTATIVENESS, AND COMPARABILITY

QA objectives for measurement data are usually expressed in terms of precision, accuracy, representativeness, completeness, and comparability (PARCC). The following sections define each of these terms.

5.3.1 PRECISION

Precision refers to the level of agreement among repeated measurement of the same characteristics, usually under a given set of conditions. Precision is expressed quantitatively as a measure of variability of a group of measurements compared to their average value. Precision is usually stated in terms of standard deviation or relative percent difference

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between measurements of the same parameter. For this project, the precision of the analytical and instrument measurement system will be assessed through the collection and analysis of field duplicate samples and the performance of laboratory analytical replicates and matrix spike/matrix spike duplicates.

Precision will be estimated by the analysis of replicate samples and will be expressed (if three or more values are determined) as the standard deviation, which is determined according to the following equation:

$$S = \left[\Sigma \frac{(X_1 - X)^2}{n - 1} \right]^{1/2}$$

where S = standard deviation

X_1 = individual measurement result

n = number of measurements, and

X = arithmetic mean of replicate measurements.

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Relative standard deviation may also be reported. If so, it will be calculated as follows:

$$RSD = 100 \frac{S}{X}$$

where RSD = relative standard deviation, expressed in percent

S = standard deviation, and

X = arithmetic mean of replicate measurement.

Precision will be estimated by calculation of relative percent difference (RPD) if only two values are determined using the following equation:

$$RPD = \frac{100\ (D_1 - D_2)}{(D_1 + D_2)/2}$$

where RPD = relative percent difference

D_1 = the larger of the two observed values

D_2 = the smaller of the two observed values

5.3.2 ACCURACY

Accuracy refers to the degree of agreement of measurement with an accepted reference or true value. Accuracy is a measure of bias in a measurement system. Sources of error that introduce bias are the sampling process, field contamination, preservation, sample handling, matrix, sample preparation, analysis techniques, and data reduction.

Analytical accuracy will be assessed using standard reference materials, matrix spikes, and surrogate spikes.

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For QC samples and surrogate spikes:

$$Percent\ Recovery = 100\ \frac{(Measured\ Value)}{(True\ Value)}$$

For matrix spikes:

$$Percent\ Recovery = 100\ \frac{(C_1 - C_0)}{C_t}$$

where C_o = value of the unspiked aliquot

C_1 = value of spiked aliquot, and

C_t = value for spike added.

Computer programs are used to report and store analytical data. These programs do not perform calculations. CDM Federal personnel check entry accuracy by proof-reading all output and comparing against the original laboratory data reports.

5.3.3 COMPLETENESS

Completeness is a measure of the amount of usable data (based on evaluation of field and laboratory QC information) obtained from a measurement system compared to the amount that was expected under normal conditions. A certain amount of data must be collected in order for conclusions based on that data to be deemed valid. A completeness goal of 90 percent has been established for this investigation by the USACE, Walla Walla.

5.3.4 REPRESENTATIVENESS

Representativeness is defined as the degree to which data accurately and precisely represent the true value of a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition intended to be characterized. Representativeness of reported results depends upon a number of considerations including, but not limited to, proper monitoring design, selection of appropriate field methodology, proper sample preparation, preservation and handling, selection and execution of appropriate analytical methodology, and proper sample identification and reporting of results.

5.3.5 COMPARABILITY

Comparability is defined as the confidence with which one data set can be compared to another. Comparability may be assessed by comparing sampling methodology, analytical methodology, and units of reported data. Comparability will be ensured through the use of Standard Operating Procedures (SOPs) for sampling and field operations as presented in the FSP. All data in a particular data set will be collected by the same methods. Data will be grouped and evaluated according to similar sampling methods, sampling media, and laboratory analytical methods. Data will be reported in comparable units. Soil concentrations will be reported in micrograms per kilogram (µg/kg) for organics and milligrams per kilogram (mg/kg) for inorganics. The analytical laboratory will use SOPs as described in their laboratory QA Plan which is attached as Attachment A. EPA approved methods will be used for all analyses. Section 9.0 lists the analytical methods chosen by the USACE for this investigation.

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5.3.6 PARCC GOALS

The proposed project specific PARCC goals for sample analysis are presented in Tables 5-1, 5-2, 5-3, and 5-4. General PARCC objectives for field measurements for the Hnu photoionization detector (PID) and Foxboro flame ionization detector (FID) organic vapor analyzer (OVA) are:

- Readability — ± 1%
- Instrument Accuracy — Accuracy variable range - 0.1 to 2,000 ppm for PID, and 1 to 1,000 ppm for FID
- Precision — ± 5%
- Completeness — 90%

These goals are based on information in the Delivery Order Statement of Work, February, 1994, the CLP Statement of Work, and levels identified for similar sites. The detection limits presented in Tables 5-1 through 5-4 are goals for all samples collected at the site. Actual analytical detection limits for each sample analyzed may vary with analytical method, matrix type and concentration of interfering contaminants.

The heading "QC Frequency" shown on Tables 5-1 through 5-4 refers to the frequency of collection of QC samples. For example, 1/10 indicates that one QC sample will be collected for every 10 field samples. The completeness percentage shown on the tables is a goal for the amount of valid, usable data to be collected.

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TABLE 5-1

DATA QUALITY OBJECTIVES FOR INORGANIC ANALYSES

Parameter	Detection Levels* Soil mg/kg	Precision RPD Solids	Spike Recovery (%)	Laboratory Control Sample (%)	QC Frequency Lab	QC Frequency Field	Completeness
Aluminum	1.6	±35	75-125	80-120	1/20	1/10	90%
Antimony	6.5	±35		80-120	1/20	1/10	90%
Arsenic	.30	±35	68-126	80-120	1/20	1/10	90%
Barium	1.4	±35	58-149	80-120	1/20	1/10	90%
Beryllium	.04	±35		80-120	1/20	1/10	90%
Cadmium	.34	±35	75-137	80-120	1/20	1/10	90%
Calcium	49	±35		80-120	1/20	1/10	90%
Chromium	.68	±35	73-137	80-120	1/20	1/10	90%
Cobalt	.68	±35		80-120	1/20	1/10	90%
Copper	2.6	±35		80-120	1/20	1/10	90%
Iron	.58	±35		80-120	1/20	1/10	90%
Lead	8.2	±35	68-133	80-120	1/20	1/10	90%
Magnesium	27	±35		80-120	1/20	1/10	90%
Manganese	.18	±35		80-120	1/20	1/10	90%
Mercury	0.02	±35	93-141	80-120	1/20	1/10	90%
Nickel	1.00	±35		80-120	1/20	1/10	90%
Potassium	62	±35		80-120	1/20	1/10	90%
Selenium	.78	±35		80-120	1/20	1/10	90%
Silver	.46	±35		80-120	1/20	1/10	90%
Sodium	34	±35		80-120	1/20	1/10	90%
Thallium	4.2	±35		80-120	1/20	1/10	90%
Vanadium	.4	±35		80-120	1/20	1/10	90%
Zinc	.44	±35	71-150	80-120	1/20	1/10	90%

* Detection levels for samples may be considerably higher depending on sample matrix.
RPD = Relative Percent Difference
mg/kg = Milligrams per kilogram
µg/l = Micrograms per liter
QC = Quality Control
TDS = Total Dissolved Solids

TABLE 5-2

DATA QUALITY OBJECTIVES FOR VOLATILE ORGANICS

Constituent	Detection Limits Soil µg/kg	Matrix Spike Recovery	MS/MSD Precision (RPD)	QC Frequency Lab	QC Frequency Field	Completeness
Chloromethane	10			1/20	1/10	90%
Bromomethane	10			1/20	1/10	90%
Vinyl Chloride	10			1/20	1/10	90%
Chloroethane	10			1/20	1/10	90%
Methylene Chloride	5			1/20	1/10	90%
Acetone	100			1/20	1/10	90%
Carbon Disulfide	5			1/20	1/10	90%
1,1-Dichloroethene	5	59-172	±22	1/20	1/10	90%
1,1-Dichloroethane (Total)	5			1/20	1/10	90%
Trans-1,2-Dichloroethene	5			1/20	1/10	90%
Chloroform	5			1/20	1/10	90%
1,2-Dichloroethane	5			1/20	1/10	90%
2-Butanone	100			1/20	1/10	90%
1,1,1-Trichloroethane	5			1/20	1/10	90%
Carbon Tetrachloride	5			1/20	1/10	90%
Vinyl Acetate	50			1/20	1/10	90%
Bromodichloromethane	5	62-137	±24	1/20	1/10	90%

TABLE 5-2 (continued)

DATA QUALITY OBJECTIVES FOR VOLATILE ORGANICS

Constituent	Detection Limits Soil µg/kg	Matrix Spike Recovery	MS/MSD Precision (RPD)	QC Frequency Lab	QC Frequency Field	Completeness
1,1,2,2-Tetrachloroethane	5			1/20	1/10	90%
1,2-Dichloropropane	5			1/20	1/10	90%
Trans-1,2-Dichloropropene	5			1/20	1/10	90%
Trichloroethene	5			1/20	1/10	90%
Dibromochloromethane	5			1/20	1/10	90%
1,1,2-Trichloroethane	5			1/20	1/10	90%
Benzene	5	66-142	±21	1/20	1/10	90%
trans-1,3-Dichloropropene	5			1/20	1/10	90%
2-Chloroethyl vinyl ether	10			1/20	1/10	90%
Bromoform	5			1/20	1/10	90%
2-Hexanone	50			1/20	1/10	90%
4-Methyl-2-pentanone	50			1/20	1/10	90%
Tetrachloroethene	5			1/20	1/10	90%
Toluene	5	59-139	±21	1/20	1/10	90%
1,1,2,2-Tetrachloroethane	5			1/20	1/10	90%
Chlorobenzene	5	60-133	±21	1/20	1/10	90%
Ethylbenzene	5			1/20	1/10	90%
Styrene	5			1/20	1/10	90%
Total Xylenes	5			1/20	1/10	90%

RPD = Relative Percent Difference
MS/MSD = Matrix Spike/Matrix Spike Duplicate
QC = Quality Control
µg/kg = Micrograms per kilogram

TABLE 5-3

DATA QUALITY OBJECTIVES FOR SEMI-VOLATILE (EXTRACTABLE) ORGANICS

Constituent	Detection Limits Soil µg/kg	Matrix Spike Recovery (%)	MS/MSD Precision (RPD)	QC Frequency Lab	QC Frequency Field	Completeness
Phenol	660	26-90	±35	1/20	1/10	90%
bis(2-Chloroethyl) ether	660			1/20	1/10	90%
2-Chlorophenol	660	25-102	±50	1/20	1/10	90%
1,3-Dichlorobenzene	660			1/20	1/10	90%
1,4-Dichlorobenzene	660	28-104	±27	1/20	1/10	90%
Benzyl Alcohol	1300			1/20	1/10	90%
1,2-Dichlorobenzene	660			1/20	1/10	90%
2-Methylphenol	660			1/20	1/10	90%
bis(-2-chloroisopropyl) ether	660			1/20	1/10	90%
4-Methylphenol	660			1/20	1/10	90%
1-Nitroso-di-n-propylamine	660	41-126	±38	1/20	1/10	90%
Hexachloroethane	660			1/20	1/10	90%
Nitrobenzene	660			1/20	1/10	90%
Isophorone	660			1/20	1/10	90%
2-Nitrophenol	660			1/20	1/10	90%
2,4-Dimethylphenol	660			1/20	1/10	90%
Benzoic Acid	3300			1/20	1/10	90%
bis(-2-Chloroethoxy) methane	660			1/20	1/10	90%
2,4-Dichlorophenol	660			1/20	1/10	90%
1,2,4-Trichlorobenzene	660	38-107	±23	1/20	1/10	90%
Naphthalene	660			1/20	1/10	90%
4-Chloroaniline	1300			1/20	1/10	90%
Hexachlorobutadiene	660			1/20	1/10	90%
4-Chloro-3-Methylphenol (para-chloro-meta-cresol)	1300	26-103	±33	1/20	1/10	90%
2-Methylnaphthalene	660			1/20	1/10	90%

TABLE 5-3 (continued)

DATA QUALITY OBJECTIVES FOR SEMI-VOLATILE (EXTRACTABLE) ORGANICS

Constituent	Detection Limits Soil µg/kg	Matrix Spike Recovery (%)	MS/MSD Precision (RPD)	QC Frequency Lab	QC Frequency Field	Completeness
Hexachlorocyclopentadiene	660			1/20	1/10	90%
2,4,6-Trichlorophenol	660			1/20	1/10	90%
2,4,5-Trichlorophenol	3300			1/20	1/10	90%
2-Chloronapthalene	660			1/20	1/10	90%
2-Nitroaniline	3300			1/20	1/10	90%
Dimethyl phthalate	660			1/20	1/10	90%
Acenapthylene	660			1/20	1/10	90%
2,6 Dinitrotoluene	660			1/20	1/10	90%
3-Nitroaniline	3300			1/20	1/10	90%
Acenapthene	660	31-137	±39	1/20	1/10	90%
2,4-Dinitrophenol	3300			1/20	1/10	90%
4-Nitrophenol	3300	11-114	±50	1/20	1/10	90%
Dibenzofuran	660			1/20	1/10	90%
2,4-Dinitrotoluene	660	28-89	±47	1/20	1/10	90%
Diethylphthalate	660			1/20	1/10	90%
4-Chlorophenyl-phenyl ether	660			1/20	1/10	90%
Fluorene	660			1/20	1/10	90%
4-Nitroaniline	3300			1/20	1/10	90%
4,6-Dinitro-2-methylphenol	3300			1/20	1/10	90%
N-Nitrosodiphenylamine	660			1/20	1/10	90%
4-Bromophenol-1-phenol ether	660			1/20	1/10	90%
Hexachlorobenzene	660			1/20	1/10	90%
Pentachlorophenol	3600	17-109	±47	1/20	1/10	90%
Phenanthrene	660			1/20	1/10	90%
Anthracene	660			1/20	1/10	90%
Di-n-Butylphthalate	660			1/20	1/10	90%
Fluoranthene	660			1/20	1/10	90%

TABLE 5-3 (continued)

DATA QUALITY OBJECTIVES FOR SEMI-VOLATILE (EXTRACTABLE) ORGANICS

Constituent	Detection Limits Soil µg/kg	Matrix Spike Recovery (%)	MS/MSD Precision (RPD)	QC Frequency Lab	QC Frequency Field	Completeness
Pyrene	660	35-142	±36	1/20	1/10	90%
Butylbenzylphthalate	660			1/20	1/10	90%
3,3-Dichlorobenzidine	1300			1/20	1/10	90%
Benzo(a)anthracene	660			1/20	1/10	90%
bis(2-Ethylhexyl) Phthalate	660			1/20	1/10	90%
Chrysene	660			1/20	1/10	90%
Di-n-octyl phthalate	660			1/20	1/10	90%
Benzo(b)fluoranthene	660			1/20	1/10	90%
Benzo(k)fluoranthene	660			1/20	1/10	90%
Benzo(a)pyrene	660			1/20	1/10	90%
Indeno(1,2,3-cd)pyrene	660			1/20	1/10	90%
Dibenzo(a,h)anthracene	660			1/20	1/10	90%
Benzo(g,h,i)perylene	660					

RPD = Relative Percent Difference
MS/MSD = Matrix Spike/Matrix spike Duplicate
µg/kg = Migrograms per kilogram
QC = Quality Control

TABLE 5-4

DATA QUALITY OBJECTIVES FOR PESTICIDES/PCBs/TRPH

Constituent	Detection Limits Soil µg/kg	Matrix Spike Recovery (%)	MS/MSD Precision	QC Frequency Lab	QC Frequency Field	Completeness
Alpha-BHC	2.0			1/20	1/10	90%
Beta-BHC	4.0			1/20	1/10	90%
Delta-BHC	6.0			1/20	1/10	90%
Gamma-BHC (Lindane)	2.7	46-127	±50	1/20	1/10	90%
Heptachlor	2.0	35-130	±31	1/20	1/10	90%
Aldrin	2.7	34-132	±43	1/20	1/10	90%
Heptachlor Expoxide	55.6			1/20	1/10	90%
Endosulfan I	9.4			1/20	1/10	90%
Dieldrin	1.3	31-134	±38	1/20	1/10	90%
4,4-DDE	2.7			1/20	1/10	90%
Endosulfan II	2.7			1/20	1/10	90%
4,4-DDD	7.5			1/20	1/10	90%
Endrin	4.0	42-139	±45	1/20	1/10	90%
Endosulfan Sulfate	44.2	42-139	±45	1/20	1/10	90%
4,4-DDT	8.0	23-134	±50	1/20	1/10	90%
Methoxychlor	117.9			1/20	1/10	90%
Endrin Aldehyde	15.4			1/20	1/10	90%
Chlordane	9.4			1/20	1/10	90%
Toxaphene	160.8			1/20	1/10	90%

TABLE 5-4 (Continued)

DATA QUALITY OBJECTIVES FOR PESTICIDES/PCBs/TRPH

Constituent	Detection Limits Soil µg/kg	Matrix Spike Recovery (%)	MS/MSD Precision	QC Frequency Lab	QC Frequency Field	Completeness
AROCLOR-1016	80.0			1/20	1/10	90%
AROCLOR-1221	80.0			1/20	1/10	90%
AROCLOR-1232	80.0			1/20	1/10	90%
AROCLOR-1242	43.6			1/20	1/10	90%
AROCLOR-1248	80.0			1/20	1/10	90%
AROCLOR-1254	160.0			1/20	1/10	90%
AROCLOR-1260	160.0			1/20	1/10	90%
TRPH	379			1/20	1/10	90%

RPD = Relative Percent Difference
MS/MSD = Matrix Spike/Matrix Spike Duplicate
µg/kg = Micrograms per kilogram
QC = Quality Control
PCBs = Polychlorinated biphenyls (a.k.a. Aroclors)
TRPH = Total recoverable petroleum hydrocarbon

6.0 PROPOSED SAMPLING ACTIVITIES AND PROCEDURES

6.1 SUMMARY OF PROPOSED FIELD ACTIVITIES

The landfill characterization and remediation at the H-06-L site will consist of trenching and excavation within previously identified areas followed by waste screening and segregation and subsurface soil/debris sampling within the resulting trenches. Subsurface soils examination and data are needed to verify the presence or absence of contamination within the geophysical anomalies previously identified at the H-06-L site.

The proposed subsurface sampling locations will be from trenches excavated within the previously identified geophysical anomalies. The areas selected for trenching will be field staked by the USACE prior to starting the work and following a utility clearance. Prior to trench excavation, geophysical surveys (magnetometer, EM-31 and radar) will be performed to confirm the boundaries of previously identified anomalies and to evaluate the potential for buried metallic objects (e.g., drums).

A formal unexploded ordnance (UXO) clearance will not be performed at the site because, based on a previous records search, UXO is not anticipated to be present. One USACE ordnance expert will be on-site during all field activities to provide supervisory support. The USACE is developing a specific ordnance plan for the site that will include contingency plans in case any UXO is encountered.

Trenching will be performed by bulldozer and backhoe tractor. Excavated materials will be screened visually and by field instruments. Any potentially hazardous materials found in the excavation will be inventoried, and segregated from suspected uncontaminated materials.

At the direction of the USACE, subsurface soil or debris samples will be collected from areas of visible discoloration and/or areas of elevated PID/FID readings. The number of subsurface soil/debris samples to be collected will be determined in the field.

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6.2 SAMPLING PROCEDURES

Sampling and measurement procedures to be used for this sampling event are in accordance with SOPs. These procedures are presented in Appendix E of the Work Plan. Appendix E of the Work Plan includes procedures for the following field operations:

- Subsurface soil sampling
- Field logbook content and control
- Sample identification.
- Sample preservation, container, volume requirements.
- Sample labeling, packaging, and shipping.
- Sample custody.
- Documentation.
- Equipment decontamination.
- Use of field equipment.

A copy of the following documents will be available to personnel in the field:

- This QAPjP.
- Work Plan and Field SOPs.
- Site Safety and Health Plan.
- Equipment Operation and Calibration Instructions.

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7.0 SAMPLE CUSTODY

7.1 CHAIN-OF-CUSTODY REQUIREMENTS

A required part of any sampling and analytical program is ensuring the integrity of the sample from collection to final disposition. This includes the ability to trace the possession and handling of samples from the time of collection, through analysis and reporting of results, and final disposition. This documentation of sample history constitutes "chain-of-custody". Components of the chain-of-custody (COC) records include the field documentation (sample labels, custody seals, a field logbook, and COC records) and laboratory documentation (COC record, laboratory sample sign-in/sign-out logbook, laboratory sample storage records, and laboratory sample disposal records).

A sample is considered to be under a person's custody if it is: (1) in a person's physical possession; (2) in view of the person after he/she has taken possession; or, (3) secured by that person so that no one can tamper with the sample.

7.1.1 SAMPLE IDENTIFICATION

Samples will be identified through the use of a coding system to identify sample locations and sample replicates (duplicates). The coding system will ensure that samples are uniquely identified, and will provide a tracking procedure to facilitate data retrieval. The coding system for subsurface soil/debris samples is presented in the Work Plan. Each sample will also be labeled with a Hanford Environmental Information System (HEIS) number to be provided by the USACE.

7.1.2 SAMPLE LABELS

Sample labels are necessary to prevent misidentification of samples. Procedures regarding sample labeling are presented in the Work Plan.

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7.1.3 CHAIN-OF-CUSTODY

To establish the documentation necessary to trace sample possession from the time of collection, a chain-of-custody record will be completed for every sample and accompany every sample to the laboratory. Chain of custody procedures presented in the Work Plan will be followed.

7.1.4 CUSTODY SEALS

Custody seals are used to detect unauthorized tampering with samples following sample collection up to the time of analysis. Custody seals will be affixed to shipping containers as described in the Work Plan.

7.1.5 FIELD LOGBOOK

All information pertinent to a field survey or sampling effort will be recorded in a field logbook. Field logbook requirements are presented in the Work Plan.

7.1.6 LABORATORY CUSTODY PROCEDURES

Samples will be shipped to two offsite laboratories for analysis. All samples will be accompanied by the chain-of-custody record. Samples will be received by the laboratory sample custodian. Upon receipt by the laboratory, each sample shipment will be inspected to assess the condition of the shipping container and the individual samples. The enclosed chain-of-custody records will be cross-referenced with all the samples in the shipment; the chain-of-custody record will then be signed and placed in the project file. A unique laboratory number will be assigned to each sample upon receipt. This number identifies the sample through all further handling. It is the laboratory's responsibility to maintain internal

log books and records that maintain the chain-of-custody throughout sample preparation and analysis, and data reporting.

7.2 SAMPLE SHIPMENT

Each sample shipped will be packed in accordance with CDM Federal's SOPs presented in the Work Plan. All shipping procedures will comply with Department of Transportation regulations. Field personnel will telephone the laboratory following shipment and provide the following information:

- The number and types of samples collected.
- Air carrier and airbill number(s).
- Estimated date and time of arrival.
- Other pertinent information, including special handling instructions, changes in scheduled sampling activity, or deviations from established sampling procedures.

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8.0 EQUIPMENT OPERATION, MAINTENANCE, CALIBRATION, AND STANDARDIZATION

All field equipment used during this project will be operated, maintained, calibrated and standardized in accordance with manufacturer's specifications. Equipment, methods and frequencies are described in the Work Plan field sampling procedures section. Each piece of field equipment will have a protocol package that contains:

- Operating Procedure.
- Routine preventative maintenance procedures including a list of critical spare parts to be available in the field.
- Calibration methods, frequency and description of calibration solutions.
- Standardization procedures (traceability to known standards).
- Precision and accuracy assessment procedures.

The equipment to be used during the landfill characterization and remediation includes the following:

- HNu (PID)
- OVA (flame ionization detector [FID])

General operating procedures for this equipment are included in Appendix E of the Work Plan. The specific operating instructions for the equipment will be available on-site.

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9.0 ANALYTICAL PROCEDURES

The purpose of the contracted project laboratory is to provide analytical data of consistent, known, and documented quality which can be used to determine the nature and extent of contamination. Project protocols and methodologies are designed to provide data of known quality in strict accordance with approved quality assurance procedures.

During the landfill characterization and remediation for Site H-06-L, samples will be analyzed by two off-site laboratories. The primary laboratory for the field samples is Environmental Science and Engineering Inc. (ESE), located in Gainesville, Florida. In addition, 10 percent of all field samples collected (a minimum of one sample) will be a duplicate sample to be analyzed by the USACE QA laboratory. The North Pacific Division Laboratory is the USACE QA laboratory designated for this project. Addresses for both laboratories are provided in the Work Plan.

As previously indicated, the number of samples to be collected and submitted for analyses will be determined in the field. Ten percent of the samples submitted to ESE, Inc. will be analyzed following CLP protocols, and ten percent will be field duplicate samples. Additional duplicate samples will be collected and submitted to the USACE QA laboratory as directed in the field by USACE personnel.

The subcontractor laboratory will adhere to EPA methods as described in their laboratory QA Plan, which is attached to this QAPjP as Attachment A. All specified procedures will be followed exactly, without deviation unless modifications are specifically authorized by CDM Federal and the USACE.

The following sections discuss the field analytical parameters, offsite analytical procedures, and general laboratory requirements to be followed.

9.1 FIELD ANALYTICAL PARAMETERS

The following parameters will be analyzed in the field:

- Total organic vapors (using a PID or FID)

9.2 LABORATORY ANALYTICAL PROCEDURES

Subsurface soils and debris samples will be sent to an off-site laboratory as part of this field program. The analyses to be performed by the off-site laboratory will reflect EPA Level III quality, except for one CLP analysis which will reflect EPA Level IV quality. The laboratory results will be evaluated against the goals and objectives set forth in Section 5.0. Analytical methods for all environmental samples are listed on Table 9-1. Additional information is presented in the Laboratory QA Plan included as Attachment A, and in the Work Plan.

9.3 LABORATORY QC CHECKS

The following laboratory QC check samples will be analyzed, as appropriate:

- Method blanks
- Blank/spikes
- Surrogates
- Matrix spikes and matrix spike duplicates
- Laboratory duplicates
- Initial and continuing calibration checks.

If the laboratory QC procedures indicate a problem with an analysis, the laboratory will notify CDM Federal immediately to determine what type of corrective action will be required. CDM Federal will in turn notify USACE personnel.

TABLE 9-1
ANALYTICAL METHODS FOR SOIL/DEBRIS SAMPLES

Analyte	Technique (a)	Extraction/Analysis Method (b)
Volatile Organics	GC/MS	8260
Semi-Volatile Organic	GC/MS	3540 / 8270
Pesticides/PCBs	GC	3510 / 8080
Barium, Cadmium, Chromium, Lead, Silver	ICP	3050 / 6010
Arsenic	AA	3050 / 7060
Selenium	AA	3050 / 7740
Mercury	CV	----- / 7471
Total Petroleum Hydrocarbons	GC/MS	9071 / 418.1W (c)

(a) AA = Atomic absorption
ICP = Inductively coupled plasma
CV = Cold Vapor
GC = Gas Chromatography
GC/MS = Gas Chromatography/ Mass Spectrometry

(b) Methods are from EPA SW-846 - Test Methods for Evaluation of Soil Wastes, 3rd Edition. 1986.

(c) Washington State modified method

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9.4 LABORATORY EQUIPMENT CALIBRATION

Laboratory calibration procedures are specified in the EPA-approved analytical methods. The Laboratory QA Plan included as Attachment A describes calibration procedures.

9.5 LABORATORY CUSTODY

The following laboratory custody procedures will be followed:

- Designation of a sample custodian.
- Correct completion by the custodian of the chain-of-custody record, including documentation of sample condition upon receipt.
- Laboratory sample tracking and documentation procedures.
- Secure sample storage (in the appropriate environment-refrigerated, dry, etc.), maintenance of sample storage records, maintenance of intra-laboratory sample custody records, documentation of proper sample disposal and disposal date.
- Proper data logging and documentation procedures including custody of all original laboratory records.

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10.0 DATA QUALITY MANAGEMENT

To ensure that data management activities provide an accurate and controlled flow of data, it is important that data handling and reporting steps be defined and implemented. Data management procedures are applicable to field and laboratory-generated data. The following sections present a description of field and laboratory data recording, validation, reduction, and reporting for this project.

10.1 DATA RECORDING AND REDUCTION

The landfill characterization and remediation sampling data will be produced through visual observations, direct reading instrumentation and measuring devices, and performance of chemical analyses. All field activities, direct reading instruments, and measuring devices will be used in accordance with procedures in the Work Plan, and specifications in equipment manufacturers' operations and maintenance manuals, as appropriate.

Field observations, direct reading instrument responses, and other measurements will be recorded in field notebooks. The Field Team Leader will be responsible for ensuring that all necessary data and information are incorporated into the logbooks while field activities are occurring. All sample identification designations will be cross referenced to their HEIS number in the logbook.

The data recorded in logbooks and forms will be transferred to tables, figures, or logs. Some data will be entered onto spread sheets to facilitate data analysis. The Project Manager will be responsible for data transfer activities including instituting QC measures to ensure that data transfers have been performed accurately. The Project Manager will also check the analytical laboratory data for completeness and reasonableness. Raw laboratory data will be reconciled with field identifiers and transferred from the laboratory reports to spread sheets. All data transferred will be checked by the CDM Federal project staff at least once for completeness and accuracy of transfer.

10.2 PROCEDURE FOR OUTLIERS

All data collected, whether analytical, field measurement, or observation, will be reviewed by the Project Manager to look for values or other conditions that do not reflect what is expected or known for the site. Analytical data outliers will be discussed with the analytical laboratory to determine if the outlier is a result of laboratory error. Field measurements and observations will be checked versus the field log and records and discussed with the individuals who collected the data to determine the possibility of error. If the outlier cannot be confirmed, it will be flagged as such.

10.3 ANALYTICAL DATA REPORTING

For samples subject to Level IV QC, analytical data reporting will be the full CLP data package or equivalent if non-CLP methodologies are used. This will include results from initial and continuing calibration, matrix spikes, matrix spike duplicates, blanks, laboratory duplicates, surrogate recoveries, chromatograms, mass spectra, and tuning data. For EPA methods not defined by the CLP, the data report will include calibration information, results from method blanks, blank/spikes, matrix spikes, and matrix spike duplicates. Chromatograms and plotted control charts associated with the blank/spikes will be presented with the data.

For samples subject to Level III QC, analytical reporting will include results from initial and continuing calibration, matrix spikes, matrix spike duplicates, blanks, laboratory duplicates, and surrogate recoveries.

10.4 DATA REPORTING

Daily Quality Control Reports (DQCR): DQCRs will be developed daily during field activities and submitted at the end of each week to the USACE. The DQCRs will include the subcontractors and equipment onsite; work performed (including samples collected and

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shipped); quality control activities; health and safety levels and activities; problems encountered and corrective action measures taken; and anticipated activities for the next day. A copy of the DQCR form is included in Appendix D of the Work Plan.

Technical Report: Upon completion of the field work and receipt of all analytical results, CDM Federal will prepare the draft Technical Report. The draft Technical Report will be submitted to the USACE approximately 24 days after demobilization from the field. The draft Technical Report will contain the following information:

- A brief narrative which summarizes the site location, history, and objectives of the landfill characterization and remediation.
- Field activities performed including sampling techniques.
- An inventory of all wastes removed from the landfill.
- A description of the numbers and types of samples collected, and the dates of collection. Included with this will be a table which lists the sample numbers and any corresponding laboratory numbers required to identify analytical results for each sample. The table will show which samples are field QA/QC samples.
- A map showing the location of all samples collected, and a map showing the limits of waste removal, and the boundaries of geophysical surveys. The information presented on the map will not be surveyed to confirm exact locations but will be plotted in the field with respect to site features.
- A brief discussion of the sample analysis results. This will include a listing of the compounds detected in each subsurface soil sample and the range of concentrations detected.
- A discussion of QC activities in the field. This will include any deviations from the QAPjP.
- The analytical data package from the laboratory will contain detection limits for all analyses, dilution factors, and appropriate data flags; laboratory QC results including instrument blanks, method blanks, surrogate spike samples, matrix spike samples, laboratory duplicates and /or matrix spike duplicates pairs; and completed chain of custody forms showing sample shipment and sample preservation.
- Discussion of whether or not DQOs were achieved.

- Results of any QA audits conducted.
- Discussion of conclusions and recommendations.
- An appendix containing all daily QC reports.

Following receipt of comments from Walla Walla USACE and other agencies, CDM Federal will incorporate the comments into the draft report and submit a final Technical Report.

10.5 DATA VALIDATION

Laboratory analytical data will not be formally validated during this investigation. However, laboratory information necessary to perform validation will be included with the Technical Report. In addition, the analytical laboratory will be required to flag data that does not meet QC requirements of the EPA methods used.

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11.0 QUALITY CONTROL CHECKS AND SAMPLES

The QC samples being sent to the offsite laboratory will include field duplicates, trip blanks, and rinsate blanks. Additional QA samples will be sent to the North Pacific Division USACE designated laboratory. Field duplicate samples will be used as a check of laboratory and field sampling procedures. Additional sample volume for matrix spike/matrix spike duplicate analyses will also be provided to the subcontracting laboratory. The following paragraphs present information on these QC samples.

Field Duplicates: Duplicate samples will be collected at a frequency of approximately 10 percent, thus a minimum of one sample out of the ten to be collected will be a field duplicate. The North Pacific Division QA laboratory will also receive duplicates at a frequency of approximately 10 percent. Duplicates will be collected, numbered, packaged, and sealed in the same manner as the other samples. The samples will not be identified as duplicates on the sample labels to the offsite laboratory. The identity of the sample as a duplicate will therefore be unknown to the laboratory personnel performing the analyses. Duplicate samples will be noted in the field logbook for documentation and verification purposes.

Trip Blanks: Trip blanks will consist of organic analyte-free water that is placed in a volatile organic analysis (VOA) sample container at the offsite laboratory and is transported from the laboratory to the sampling site. Trip blanks then accompany volatile organic compound (VOC) samples during collection and are shipped back to the offsite laboratory. The trip blank is analyzed for the same parameters as the other volatile samples. Trip blanks will be submitted at a frequency of approximately 10 percent of the coolers containing volatile samples. The Field Team Leader will be responsible for determining which coolers will contain trip blanks.

Rinsate Blanks: Equipment rinsate blanks will be comprised of the final analyte-free rinse water from decontamination of sampling equipment. These blanks are a check to verify the

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effectiveness of decontamination procedures. Rinsate samples will be collected at a minimum frequency of one in 20 samples.

Matrix spike/matrix spike duplicates (MS/MSD): As required by the analytical protocols, some samples will be designated as MS/MSD samples. These samples contain extra sample volume and are used by the offsite laboratory to meet QA/QC requirements. To the extent possible, the samples designated as MS/MSD should contain contaminants. MS/MSD samples will be collected at a frequency of ten percent (1 per 10) or as otherwise directed by the laboratory. Field personnel should contact the laboratory to determine the specific volume requirements for these samples.

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12.0 QUALITY ASSURANCE OVERSIGHT

12.1 AUDITS

Requirements for audits are the responsibility of the CDM Federal QA Director. Audits are scheduled on a quarterly basis by the CDM Federal QA Director. All audits will meet the requirements stated in the CDM Federal Quality Assurance Manual, Part One, Revision Number 1, January 15, 1993 and Part Two, Revision Number 5, October 15, 1993 and will conform to the USACE CEQAPP 1.1 dated June 15, 1993. System audits are qualitative reviews of project activity, and QC measure implementation to check that the overall QA program is functioning. These may include field, laboratory, and office audits. No performance or system audits are currently planned for this delivery order.

Following an audit, the QA Director or designated audit staff will develop an audit report that summarizes the audit findings, including those areas found to be in non-conformance (if any). This report will be submitted to the CDM Federal Project Manager to identify appropriate corrective actions. Resolution of corrective action requests is addressed in the CDM Federal QA Manual, Part Two (1993).

12.2 CORRECTIVE ACTION REQUIREMENTS

Throughout this QAPjP, various control limits have been specified that, if exceeded, require corrective action. These limits include target levels for precision, accuracy, completeness, QC sample types, and criteria for representativeness and comparability. The need for corrective action may also result from performance or system audits. USACE will be notified immediately if data do not meet the QA objectives.

Responsibility and procedures for identifying and reporting nonconformances is described in the CDM Federal QA Manual Parts One and Two. Nonconformances with the established quality control procedures will be identified and no additional work (which is dependent upon

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the nonconforming activity) will be performed until the nonconformance is corrected. In all cases, corrective action procedures will be implemented to the satisfaction of the USACE.

If a nonconformance or deficiency is identified during routine work or during a CDM Federal audit, the USACE will be notified, and corrective action will be initiated by CDM Federal and its subcontractors. The corrective action-steps are:

- Identify and define the problem;
- Assign responsibility for investigating the problem;
- Determine corrective action to eliminate the problem;
- Assign responsibility for implementation of the corrective action;
- Implement the corrective action;
- Verify that the corrective action has eliminated the problem;
- Document the problem identified, the corrective action taken, and its effectiveness in eliminating the problem.

The person identifying a deficiency or nonconformance initiates a corrective action request and submits it to the CDM Federal QA Director, who assigns responsibility for responding to the request. The QA coordinator is responsible for following up on the request and monitoring the implementation of appropriate corrective actions.

Corrective action procedures that might be implemented from audit results or detection of unacceptable data are developed on a case-by-case basis. Such actions may include altering procedures in the field, resampling and/or retesting, obtaining new equipment or supplies, or additional staff training.

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12.3 QA REPORTS TO MANAGEMENT

Periodic reporting keeps CDM Federal management, project management, and clients informed of QA implementation. Monthly reports prepared by the QA staff summarize the following:

- Activities conducted during the reporting period.
- Audits conducted.
- Quality problems found.
- Corrective actions taken.
- QA project plans reviewed and approved during the reporting period.

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ATTACHMENT A
LABORATORY
QUALITY ASSURANCE MANUAL

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LCQAP August 1993

Laboratory Comprehensive Quality Assurance Plan

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ESE, 1994

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APPROVALS

This Quality Assurance/Quality Control (QA/QC) Manual has been read and understood and approved for use in the Gainesville Laboratory of Environmental Science and Engineering, Inc. (ESE), Southeast Region.

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Vice President

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Control No. 003

LCQAP August 1993

Laboratory Comprehensive Quality Assurance Plan

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5-15	Reporting Limit Data for Volatile Organic Compounds, EPA 524.2	5.40	5/17/93
5-16	Analytes, Precision, and Accuracy Data For N-Methyl Carbamoxyloximes and N-Methyl Carbamates, EPA 531.1	5.43	5/17/93
5-17	Reporting Limit Data for N-Methyl Carbamoxyloximes and N-Methyl Carbamates, EPA 531.1	5.44	5/17/93
5-18	Analytes, Precision, and Accuracy Data for Purgeable Halocarbons, EPA 601 and SW 5030/8010	5.45	5/17/93
5-19	Reporting Limit Data for Purgeable Halocarbons, EPA 601 and SW 5030/8010	5.47	5/17/93
5-20	Analytes, Precision, and Accuracy Data for Purgeable Aromatics, EPA 602 and SW 5030/8020	5.49	5/17/93
5-21	Reporting Limit for Purgeable Aromatics, EPA 602 and SW 5030/8020	5.50	5/17/93
5-22	Analytes, Precision, and Accuracy Data for Phenols, EPA 604 and SW 3510/3520/3540/3550/8040	5.51	5/17/93
5-23	Reporting Limit Data for Phenols, EPA 604 and SW 3510/3520/3540/3550/8040	5.52	5/17/93
5-24	Analytes, Precision, and Accuracy Data for Benzidines, EPA 605	5.53	5/17/93

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Table No.	Description	Page No.	Revision Date
5-25	Reporting Limit Data for Benzidines, EPA 605	5.54	5/17/93
5-26	Analytes, Precision, and Accuracy Data for Phthalate Esters, EPA 606 and SW 3510/3520/3540/3550/8060	5.55	5/17/93
5-27	Reporting Limit Data for Phthalate Esters, EPA 606 and SW 3510/3520/3540/3550/8060	5.56	5/17/93
5-28	Analytes, Precision, and Accuracy Data for Organochlorine Pesticides and PCBs, EPA 608/617 and SW 3510/3520/3540/3550/8080	5.58	5/17/93
5-29	Reporting Limit Data for Organochlorine Pesticides and PCBs, EPA 608/617 and SW 3510/3520/3540/3550/8080	5.60	5/17/93
5-30	Analytes, Precision, and Accuracy Data for Polynuclear Aromatic Hydrocarbons, EPA 610 and SW 3510/3520/3540/3550/8310	5.62	5/17/93
5-31	Reporting Limit Data for Polynuclear Aromatic Hydrocarbons, EPA 610 and SW 3510/3520/3540/3550/8310	5.64	5/17/93
5-32	Analytes, Precision, and Accuracy Data for Chlorinated Herbicides, EPA 615 and SW 8150	5.66	5/17/93
5-33	Reporting Limit Data for Chlorinated Herbicides, EPA 615 and SW 8150	5.67	5/17/93
5-34	Analytes, Precision, and Accuracy Data for Organophosphorus Pesticides, EPA 622/614 and SW 3510/3520/3540/3550/8140	5.68	5/17/93

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Table No.	Description	Page No.	Revision Date
5-35	Reporting Limit Data for Organophosphorus Pesticides, EPA 614/622 and SW 3510/3520/3540/3550/8140	5.71	5/17/93
5-36	Analytes, Precision, and Accuracy Data for Volatile Organic Compounds, EPA 624 and SW 5030/8240/8260	5.73	5/17/93
5-37	Reporting Limit Data for Volatile Organic Compounds, EPA 624 and SW 5030/8240/8260	5.77	5/17/93
5-38	Analytes, Precision, and Accuracy Data for Semivolatile Organic Compounds, EPA 625 and SW 3510/3520/3540/3550/8270	5.80	5/17/93
5-39	Reporting Limit Data for Semivolatile Organic Compounds, EPA 625 and SW 3510/3520/3540/3550/8270	5.89	5/17/93
5-40	Analytes, Precision, and Accuracy Data For Carbamates and Urea Pesticides, EPA 632 and Modified 632	5.96	5/17/93
5-41	Reporting Limit Data for Carbamates and Urea Pesticides, EPA 632 and Modified 632	5.97	5/17/93
5-42	Analytes, Precision, and Accuracy Data for Chlorinated Hydrocarbons, EPA 612 and SW 3510/3520/3540/3550/8120	5.98	5/17/93
5-43	Reporting Limit Data for Chlorinated Hydrocarbons, EPA 612 and SW 3510/3520/3540/3550/8120	5.99	5/17/93
5-44	Analytes, Precision, and Accuracy Data for Triazines, EPA 619	5.100	5/17/93

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Table No.	Description	Page No.	Revision Date
5-45	Reporting Limit Data for Triazines, EPA 619	5.101	5/17/93
5-46	Analytes, Precision, and Accuracy Data for Organonitrogen Pesticides, EPA 633	5.102	5/17/93
5-47	Reporting Limit Data for Organonitrogen Pesticides, EPA 633	5.103	5/17/93
5-48	Analytes, Precision, and Accuracy Data for Certain Amine Pesticides and Lethane, EPA 645	5.104	5/17/93
5-49	Reporting Limit Data for Certain Amine Pesticides and Lethane, EPA 645	5.105	5/17/93
5-50	Analytes, Precision, and Accuracy Data for Nitroaromatics and Nitramines by High Performance Liquid Chromatography (HPLC), SW 8330	5.106	5/17/93
5-51	Reporting Limit Data for Nitroaromatics and Nitroamines by High Performance Liquid Chromatography, SW 8330	5.107	5/17/93
5-52	Analytes, Precision, and Accuracy Data for Nitroaromatics and Nitramines by High Performance Liquid Chromatography (HPLC), UW32 and LW12	5.108	5/17/93
5-53	Reporting Limit Data for Nitroaromatics and Nitroamines by High Performance Liquid Chromatography, UW32, and LW12	5.109	5/17/93
5-54	Analyte, Precision, and Accuracy Data for Glyphosate, EPA 547 (Modified)	5.110	5/17/93
5-55	Reporting Limit Data for Glyphosate, EPA 547 (Modified)	5.111	5/17/93

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Table No.	Description	Page No.	Revision Date
5-56	Analyte, Precision, and Accuracy Data for Ethylene-Bis-Dithiocarbamates (EBDC), EPA 630.1 (Modified)	5.112	5/17/93
5-57	Reporting Limit Data for Ethylene-Bis-Dithiocarbamates (EBDC), EPA 630.1 (Modified)	5.113	5/17/93
5-58	Analytes, Precision, and Accuracy Data for Organochlorine Pesticides and PCBs in Water, EPA 617	5.114	5/17/93
5-59	Reporting Limit Data for Organochlorine Pesticides and PCBs in Water, EPA 617	5.116	5/17/93
5-60	Analyte, Precision, and Accuracy Data for Tetrazene, EPA 8331	5.118	5/17/93
5-61	Reporting Limit Data for Tetrazene, EPA 8331	5.119	5/17/93
6-1	Sample Container Cleaning Procedures Within the Laboratory	6.2	5/17/93
6-2	Required Containers, Preservation Techniques, and Holding Times	6.6	5/17/93
6-3	Reagent Storage	6.12	5/17/93
8-1	Glassware Cleaning Procedures	8.6	5/17/93
8-2	Laboratory Method Modification Compounds	8.8	5/17/93
9-1	Standard Sources and Preparation	9.3	5/17/93
9-2	List of Laboratory Instruments	9.5	5/17/93
9-3	Mass Intensity Specifications for DFTPP and BFB	9.13	5/17/93

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Table No.	Description	Page No.	Revision Date
9-4	Standardization of Titrating Solutions	9.25	5/17/93
11-1	Methods Used to Generate Precision and Accuracy Targets	11.11	5/17/93
13-1	Summary of Corrective Action Procedures for Metals Analyzed by Graphite Furnace and Cold Vapor Atomic Absorption Spectroscopy	13.4	5/17/93
13-2	Summary of Corrective Action Procedures for Metals Analyzed by Inductively Coupled Plasma Emission Spectroscopy	13.6	5/17/93
13-3	Summary of Corrective Action Procedures for Inorganics, Oil and Grease, Petroleum Hydrocarbons, and TOX	13.8	5/17/93
13-4	Summary of Corrective Action Procedures for Radionuclides	13.10	5/17/93
13-5	Summary of Corrective Action Procedures for Organics Analyzed by Gas Chromatography and High Pressure Liquid Chromatography	13.12	5/17/93
13-6	Summary of Corrective Action Procedures for Organics by Gas Chromatography/Mass Spectrometry	13.15	05/17/93

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LIST OF ACRONYMS AND ABBREVIATIONS

AAS	atomic absorption spectrophotometry
AIHA	American Industrial Hygiene Association
ASTM	American Society for Testing and Materials
BFB	bromofluorobenzene
BOD	biochemical oxygen demand
°C	degrees Celsius
CCC	calibration check compounds
CCV	continuing calibration verification
CLASS	Chemical Laboratory Analysis and Scheduling System
COD	chemical oxygen demand
D	detection limit
DBCP	1,2-Dibromo-3-chloropropane
DFTPP	decafluorotriphenylphosphine
DHRS	Department of Health and Rehabilitative Services
DI	deionized
DO	dissolved oxygen
DOT	Department of Transportation
ECD	electron capture detector
EDB	1,2-Dibromoethane
ELAP	Environmental Laboratory Approval Program
EPA	U.S. Environmental Protection Agency
ESE	Environmental Science & Engineering, Inc.
eV	electronvolt
FDER	Florida Department of Environmental Regulation
FID	flame ionization detector
FPD	flame photometric detector
FR	fraction code

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LIST OF ACRONYMS AND ABBREVIATIONS
(Continued, Page 2 of 5)

FRN	frame reference number
ft	foot
g	gram
g/kg	grams per kilogram
GC	gas chromatography
GC/FID	GC employing flame ionization detection
GC/FPD	GC employing flame photometric detection
GC/HPLC	gas chromatography/high performance liquid chromatography
GC/MS	gas chromatograph/mass spectrometer
GC/MS/DS	gas chromatography/mass spectrometry/data system
GC/NPD	GC employing nitrogen-phosphorus detection
GLP	Good Laboratory Practice
HCL	hydrochloric acid
HNO_3	nitric acid
HPLC	high performance liquid chromatography
H_2SO_4	sulfuric acid
ICAP	inductively coupled argon plasma
ICS	interference check solution
ICV	initial calibration verification
ID	identification
IR	infrared
KCl	potassium chloride
kg	kilogram
KOH	potassium hydroxide
L	liter

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LIST OF ACRONYMS AND ABBREVIATIONS
(Continued, Page 3 of 5)

LC50	50 percent lethal concentration
MBAS	methylene blue active substances
MDL	method detection limits
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mL	milliliter
mm	millimeter
mm^2	square millimeter
MSC	matrix spike compound
NaOH	sodium hydroxide
$Na_2S_2O_3$	sodium thiosulfate
ng	nanogram
NIOSH	National Institute of Occupational Safety and Health
NIST	National Institute of Standards and Technology
NTU	nephelometric turbidity unit
PAT	Proficiency Analytical Testing Program
PCB	polychlorinated biphenyl
PCP	pentachlorophenol
PCU	platinum-cobalt unit
% RSD	percent relative standard deviation
PFS	prefield setup
PID	photoionization device
PNA	polynuclear aromatic hydrocarbon
ppb	parts per billion

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued, Page 4 of 5)

ppt	parts per thousand
psi	pounds per square inch
PVC	polyvinyl chloride
QA	quality assurance
QA/QC	quality assurance/quality control
QC	quality control
QCC	quality control check
RF	response factor
RPD	relative percent difference
S	surrogate
SCT	salinity, conductivity, and temperature
SDS	sodium dodecyl sulfate
SOP	standard operating procedure
STORET	storage and retrieval
THMS	trihalomethanes
TIC	tentatively identified compound
TOC	total organic carbon
TOX	total organic halides
TRPH	total recoverable petroleum hydrocarbons
µg/g	micrograms per gram
µg/L	micrograms per liter
µL	microliter
µmho/cm	micromhos per centimeter
UPS	United Parcel Service
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey

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LIST OF ACRONYMS AND ABBREVIATIONS
(Continued, Page 5 of 5)

UV	ultraviolet
VOC	volatile organic compound
YSI	Yellow Springs Instruments

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3.0 STATEMENT OF POLICY

3.1 QUALITY ASSURANCE (QA) STATEMENT OF POLICY

It is the policy of Environmental Science & Engineering, Inc. (ESE), Gainesville Laboratory, to maintain an active quality assurance/quality control (QA/QC) program to provide the highest quality information and ensure the highest professional standards in deliverables for every project undertaken. An established QA/QC philosophy and program are essential for any organization to consistently produce valid laboratory data. To be valid, data must be generated under controlled conditions which do not adversely affect data quality. Data must also be interpreted by capable professionals who are trained in appropriate scientific disciplines, maintain a current knowledge of their field, and are experts in the applications for which the data will be used. The objectives of the QA/QC program are to estimate the quality of each analytical system including precision, accuracy, and sensitivity sufficient for each project. The QA/QC program also assists in the early recognition of deficiencies which might affect data quality, validate data, and define data usability.

ESE's commitment to the QA/QC process is evidenced by the establishment of a separate QA/Safety Division which is responsible for overseeing QA activities and an internal QA/QC department which is responsible for overseeing QA and QC activities within the Gainesville Laboratory. QA is a management system which ensures the completion of predetermined activities. All activities are recorded including traceability, completeness, and document security. QC refers to specific actions taken to ensure that system performance is consistent with established limits. These actions ensure precision, accuracy, comparability, and completeness of analytical data.

ESE supports a corporate-wide Quality Education System (QES). All employees are trained in the quality improvement process. This training is supplemented at the departmental level by instructing employees on the importance of QA/QC and the price of nonconformance.

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3.2 SCOPE

All major environmental studies and analyses conducted by ESE Gainesville Laboratory for projects under the guidance of the Department of Energy (DOE), the Naval Energy And Environmental Support Activity (NEESA), the Hazardous Waste Remedial Actions Program (HAZWRAP), the Florida Department of Environmental Regulations (FDER) or any state and federal government agency must be performed in accordance with this Laboratory Comprehensive Quality Assurance Plan (LCQAP).

This LCQAP will be the basis for all project-specific QA plans except where alternate QA plans are required. When appropriate, this LCQAP will be filed with a client and/or regulatory agency and, once approved, may be referenced in lieu of repetitive submission of plans in which only a portion of the information is changed.

3.3 DOCUMENT CONTROL

This LCQAP will be revised periodically as procedural changes become necessary. Changes will be documented by the date and revision number of each section. ESE's QA/QC Department will keep a distribution list and assign a unique number to each copy of the LCQAP. When a section is revised, the revision date will replace the original date in the heading code, the revision number will be changed, and the table of contents will be updated. Copies of the revised sections will be provided to each individual on the distribution list.

These procedures will apply once the plan has been finalized and implemented; these procedures will not apply to draft documents.

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4.0 ORGANIZATION AND RESPONSIBILITIES

4.1 LABORATORY OPERATIONS CAPABILITIES

ESE laboratory operations include the following capabilities:

1. Groundwater and surface water analysis,
2. Soil and sediment analysis,
3. Wastewater analysis,
4. Air monitoring screening,
5. Drum analysis, and
6. Underground storage tank analysis.

4.2 KEY PERSONNEL

This section includes ESE's Gainesville Laboratory key personnel identified by title and a brief summary of each individuals responsibilities. An organization chart of the Gainesville Laboratory is presented in Figure 4-1.

4.2.1 LABORATORY OPERATIONS PERSONNEL

4.2.1.1 Laboratory Director

The Laboratory Director is responsible for the overall management of the analytical laboratory, including the appointment and supervision of the Laboratory Information Services Manager, Laboratory Division Managers, Customer Service Manager, and Laboratory QA/QC Manager. He is responsible for approving all analytical procedures and associated QA/QC procedures.

4.2.1.2 Laboratory QA/QC Manager

The Laboratory QA/QC Manager is responsible for the overall management of the laboratory QA/QC operations, including the appointment and supervision of the Laboratory QA/QC Coordinators.

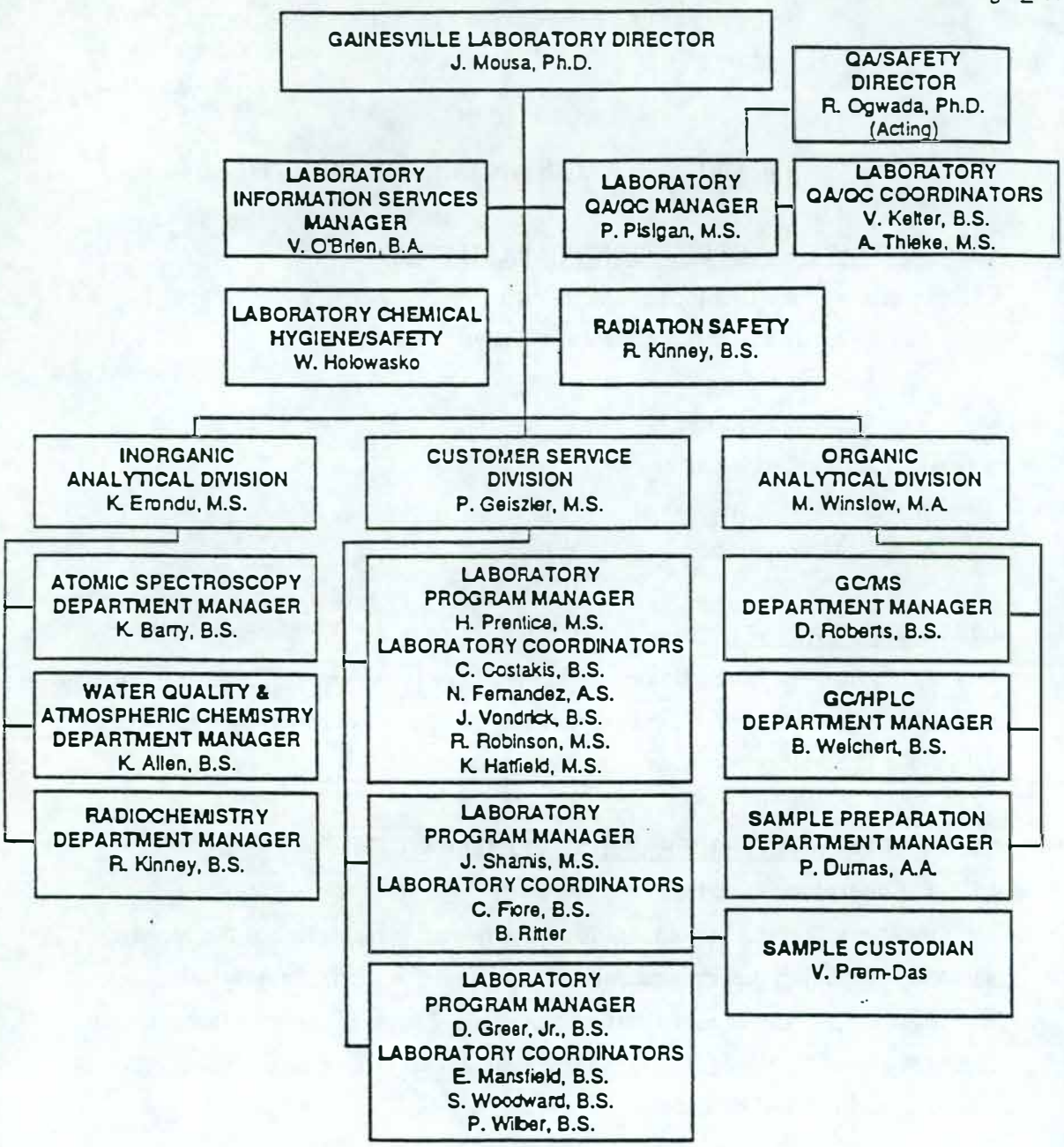

Figure 4-1
ESE GAINESVILLE LABORATORY ORGANIZATION CHART

SOURCE: ESE

ENVIRONMENTAL SCIENCE & ENGINEERING, INC.

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4.2.1.3 Laboratory QA/QC Coordinator

The Laboratory QA/QC Coordinator is responsible for coordinating the certification programs of the Gainesville Laboratory. The Laboratory QA/QC Coordinator also performs laboratory and data audits, and maintains QC records for inspection by ESE project management and the Project QA Coordinator. The Laboratory QA/QC Coordinator provides guidance and coordination to resolve any QA/QC deficiencies and reviews precision, accuracy, and blind samples for projects to ensure completeness of the QC data.

4.2.1.4 Laboratory Information Services Manager

The Laboratory Information Services Manager oversees ESE's computerized data management system and is responsible for the following:

1. Maintaining ESE's Chemical Laboratory Analysis Scheduling System (CLASS™) (refer to Section 10.1);
2. Approval of all changes made to CLASS™; and
3. Storage of chain-of-custody logsheets, analytical batch folders for all departments in one central location, and all other computerized data.

4.2.1.5 Laboratory Division Managers

The Analytical Laboratory Division Managers are responsible for the overall management of their respective analytical inorganic and organic sections or including the appointment and supervision of their Department Managers. The Customer Service Manager is responsible for the overall management of the project operations within the laboratory including the appointment and supervision of the Laboratory Program Manager.

4.2.1.6 Laboratory Program Manager

The Laboratory Program Manager is responsible for the overall management of the project operations within the Gainesville Laboratory, including the appointment and supervision of the Laboratory Coordinators and Sample Custodian.

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4.2.1.7 Laboratory Coordinator

The Laboratory Coordinator acts as liaison between field and laboratory operations and is responsible for the following:

1. Coordination of sample analyses to meet project or client objectives;
2. Preparation of analytical reports, including coordination with the QA Division or Laboratory QA/QC Manager and laboratory management to ensure that the data are validated prior to release to the client;
3. Review of any QA/QC deficiencies reported by the Laboratory Department Manager; and
4. Coordination of any data changes resulting from review by the Laboratory QA/QC Coordinator, and/or Project Manager.

4.2.1.8 Sample Custodian

The Sample Custodian checks in the samples from the field upon receipt by the laboratory. The Sample Custodian compares all samples contained in the shipment to the logsheet(s) to ensure that all samples designated on the logsheet have been received. The Sample Custodian will note any special remarks concerning the shipment and deliver the logsheet to the Laboratory Information Services Manager. The Sample Custodian places samples in appropriate storage areas and notifies the appropriate Laboratory Coordinators and Laboratory Department Managers, or designee.

4.2.1.9 Laboratory Department Managers

The Laboratory Department Managers are responsible for providing consistent and accurate laboratory data and technical reports produced by their analysts. These individuals are responsible to the Project Manager to ensure that all personnel under their direction are knowledgeable of the QA/QC requirements of the project and that all QC and technical review procedures are followed and documentation is provided.

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4.1.10 Laboratory Analyst

Laboratory Analysts must perform preliminary QC checks to ensure that each batch of data being generated passes all the required QC criteria.

4.1.11 Radiation Safety Officer

The Radiation Safety Officer is responsible for enforcing company policy in handling radioactive materials in order to ensure protection of all ESE employees and facilities from exposure to radiation. He is responsible for evaluating new requirements by Florida DHRS and/or NRC to ensure that ESE's Radioactive Materials License is in compliance and reviewing and evaluating standard operating procedures and sections of the Laboratory Safety Manual involving the use of radioactive materials for appropriateness. He is also responsible for monitoring spills and leaks in areas where radioactive materials are used, leak testing and documenting all sealed and unsealed radiation sources, and issuing, collecting and shipping personal monitoring devices. He conducts radiation safety training of all personnel prior to their handling of radioactive materials, and maintains an inventory of all radioactive materials. He will remove and maintain documentation for the removal of radioactive samples as necessary to a temporary storage area within the company facility.

4.1.12 Laboratory Chemical Hygiene Officer

The Chemical Hygiene Officer (CHO) will assist laboratory supervisors in implementing the Chemical Hygiene Program. He will provide training (in accordance with Health and Safety (H&S) SOP 112- Chemical Hygiene Program Training), review laboratory safety manuals and SOPs, and perform safety audits of laboratory procedures and safety inspections of laboratory protective equipment to determine compliance. Areas of non-compliance will be reported to the appropriate supervisor or manager. The CHO will make this Program readily available to laboratory workers and supervisors. He will evaluate worker chemical exposure (in accordance with H&S SOP 140) and will provide a written report of each exposure assessment or determination to the Laboratory Director for action as necessary. Any over exposure shall be reported to the Regional Health and Safety Coordinator (RHSC).

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4.2.2 QA PERSONNEL

4.2.2.1 ESE QA/Safety Director

The ESE QA/Safety Director maintains ESE's overall QA program and interacts with the Corporate Officers, Division Managers, and the Laboratory QA/QC manager to ensure compliance with approved QA/QC plans. He may review QA/QC reports to the Project Manager and the client, and may be responsible for approving QA/QC procedures. Formulation of QA policy and the formulation of the Quality Assurance Program is the responsibility of QA/Safety Director, who reports to ESE's NE Region Manager.

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5.0 QA OBJECTIVES FOR MEASUREMENT DATA

5.1 LABORATORY ANALYSIS

Analyses are performed according to standard U.S. Environmental Protection Agency (EPA) analytical procedures for analysis of water and soil/sediment unless otherwise specified (Tables 5-1 through 5-61). EPA precision and accuracy data and historic ESE data were used as the basis for developing criteria to assess laboratory method performance and the precision and accuracy of sample data, as noted. These limits are subject to change based on actual historic and current performance; updates will be provided for insertion into all control copies of our site-specific QAPPs, as appropriate. Specific compounds are used for controlling purposes in multianalyte methods and are identified in Tables 5-2 through 5-61. Laboratory method performance is evaluated using calibration checks, blanks, and QC check samples; sample accuracy and precision are evaluated using matrix spike and matrix spike duplicate data.

The detection limits (DLs) achievable for all parameters are listed in Tables 5-3 through 5-61 (odd numbered tables). These DLs were developed in accordance with specific procedures referenced for each analytical method. The DLs for waters and calculated for solids are typically reported as DLs, if no matrix and/or other interferences (i.e., instrument noise) are found to be present (subject to adjustment for dilutions and/or moisture contents).

The following is a brief explanation of the terms that appear in Tables 5-2 through 5-61. Items that are not applicable are denoted by NA.

Reference: The reference of the standard analytical methodology used for each procedure.

Precision: Evaluated based on the relative percent difference (RPD) of duplicate spikes (see Section 11.0 for definitions).

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Accuracy: Evaluated based on the percent recovery of each spike (see Section 11.0 for definition).

Units: Volume in liters (L) [e.g., micrograms per liter (μg/L)] indicates a water matrix; control spikes are added to either sample matrices or to organic-free laboratory water. Mass in grams (g) or kilograms (kg) [e.g., milligrams per kilogram (mg/kg)] indicates a soil/sediment matrix; control spikes are added to sample matrices, soil, or blank water, depending on the analytical procedure.

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Table 5-1. Sample Preparation Methods

Sample Preparation Method Number	Description	Matrix	Sample Preparation for Methods
EPA 3005	Acid Digestion	Aqueous	EPA 6010, 7020, 7200, 7210, 7450, 7480, 7610, 7770
EPA 3010	Acid Digestion	Aqueous	EPA 6010, 7020, 7200, 7210, 7450, 7480, 7610, 7770
EPA 3020	Acid Digestion	Aqueous	EPA 7041, 7060, 7091, 7131, 7191, 7201, 7210, 7421, 7470, 7471, 7481, 7740, 7841, 7911
EPA 3050	Acid Digestion	Solid	EPA 6010, 7020, 7200, 7210, 7450, 7480, 7610, 7770, 7041, 7060, 7091, 7131, 7191, 7201, 7210, 7421, 7470, 7471, 7481, 7740, 7841, 7911
EPA 3510	Separator Funnel Liquid-Liquid Extraction	Aqueous	EPA 8040, 8060, 8080, 8120, 8140, 8270, 8310
EPA 3520	Continuous Liquid-Liquid Extraction	Aqueous	EPA 8040, 8060, 8080, 8120, 8140, 8270, 8310
EPA 3540	Soxhlet Extraction	Solid	EPA 8040, 8060, 8080, 8120, 8140, 8270, 8310
EPA 3550	Sonication Extraction	Solid	EPA 8040, 8060, 8080, 8120, 8140, 8270, 8310
EPA 5030	Purge-And-Trap	Aqueous, Solid	EPA 8010, 8020, 8240, 8260
EPA 3630	Silica Gel Cleanup	Aqueous, Solid	EPA 8080
EPA 3640	Gel-Permeation Cleanup	Aqueous, Solid	EPA 8080, 8140, 8270*
EPA 3660	Sulfur Cleanup	Aqueous, Solid	EPA 8080, 8120

*Only used for fish, oily, or highly contaminated samples.
Source: ESE.

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Table 5-2. Summary of Precision and Accuracy Criteria for Inorganics Analysis, Metals Analysis, Oil and Grease, TRPH, TOX, and Radiochemical Analysis

Parameter	Units	Reference	Method Criterion[b,c] Precision (Max RPD)	Method Criterion[b,c] Accuracy (Percent Recovery)
Aluminum, Total	µg/L	EPA 200.7, 202.2, 3005, 3010, 6010	16	81-113
Aluminum, Solid	mg/kg	EPA 3050, 7020, 6010[e]	21[e]	75-117[e]
Antimony, Total[f]	µg/L	EPA 204.2, 3020, 7041	25[d]	75-125[d]
Antimony, Total[f]	µg/L	EPA 200.7, 3005, 3010, 6010	15	79-109
Antimony, Solid[f]	mg/kg	EPA 3050, 6010	15	79-109
Antimony, Solid[f]	mg/kg	EPA 3050, 7041	25[d]	75-125[d]
Arsenic, Total[f]	µg/L	EPA 206.2, 3005, 3010, 6010[e], 3020, 7060	24	72-120
Arsenic, Solid[f]	mg/kg	EPA 3050, 7060, 6010[e]	24	72-120
Barium, Total[f]	µg/L	EPA 208.2	25[d]	75-125[d]
Barium, Total[f]	µg/L	EPA 200.7, 3005, 3010, 6010	10	86-106
Barium, Solid[f]	mg/kg	EPA 3050, 6010	10	86-106
Beryllium, Total[f]	µg/L	EPA 210.2, 3020, 7091	25[d]	75-125[d]
Beryllium, Total[f]	µg/L	EPA 200.7, 3005, 3010, 6010	15	78-108
Beryllium, Solid[f]	mg/kg	EPA 3050, 6010	15	78-108
Beryllium, Solid[f]	mg/kg	EPA 3050, 7091	25[d]	75-125[d]
Cadmium, Total[f]	µg/L	EPA 213.2, 3020, 7131	25[d]	75-125[d]
Cadmium, Total[f]	µg/L	EPA 200.7, 3005, 3010, 6010	14	80-108
Cadmium, Solid[f]	mg/kg	EPA 3050, 6010	14	80-108
Cadmium, Solid[f]	mg/kg	EPA 3050, 7131	25[d]	75-125[d]
Calcium, Total[f]	mg/L	EPA 200.7[a], 3005, 3010, 6010[e]	19	78-116
Calcium, Solid[f]	mg/kg	EPA 3050, 6010[e]	28[e]	60-116[e]
Chromium, Total[f]	µg/L	EPA 218.1, 3020, 7191	16	80-112
Chromium, Total[f]	µg/L	EPA 200.7, 3005, 3010, 6010	15	79-109
Chromium, Solid[f]	mg/kg	EPA 3050, 6010	15	79-109
Chromium, Solid[f]	mg/kg	EPA 3050, 7191	16	80-112
Cobalt, Total[f]	µg/L	EPA 219.2, 3020, 7201	25[d]	75-125[d]
Cobalt, Total[f]	µg/L	EPA 200.7, 3005, 3010, 6010	10	85-105
Cobalt, Solid[f]	mg/kg	EPA 3050, 6010	10	85-105
Cobalt, Solid[f]	mg/kg	EPA 3050, 7200, 7201	25[d]	75-125[d]

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Table 5-2. Summary of Precision and Accuracy Criteria for Inorganics Analysis, Metals Analysis, and Oil and Grease, TRPH, TOX, and Radiochemical Analysis (Continued, Page 2 of 11)

Parameter	Units	Reference	Method Criterion[b,c] Precision (Max RPD)	Method Criterion[b,c] Accuracy (Percent Recovery)
Copper, Total[f]	µg/L	EPA 220.1, 220.2, 3020, 7210	25[d]	75-125[d]
Copper, Total[f]	µg/L	EPA 200.7, 3005, 3010, 6010	12	84-108
Copper, Solid[f]	mg/kg	EPA 3050, 6010	12	84-108
Copper, Solid[f]	mg/kg	EPA 3050, 7210	25	75-125
Iron, Total	µg/L	EPA 200.7, 3005, 3010, 6010	18	77-113
Iron, Solid	mg/kg	EPA 3050, 6010[a]	11[e]	86-108[e]
Lead, Total[f]	µg/L	EPA 239.2, 3020, 7421	27	71-125
Lead, Total[f]	µg/L	EPA 200.7, 3005, 3010, 6010	15	79-109
Lead, Solid[f]	mg/kg	EPA 3050, 6010.	15	79-109
Lead, Solid[f]	mg/kg	EPA 3050, 7421	27	71-125
Magnesium, Total	mg/L	EPA 200.7[a], 242.1, 3005, 3010, 6010[a]	10	86-106
Magnesium, Solid	mg/kg	EPA 3050, 7450, 6010[a]	53[e]	28-134[e]
Manganese, Total	µg/L	EPA 243.2	25[d]	75-125[d]
Manganese, Total	µg/L	EPA 200.7, 3005, 3010, 6010	12	83-107
Manganese, Solid	mg/kg	EPA 3050, 6010	12	83-107
Manganese, Solid	mg/kg	EPA 3050, 7460	25[d]	75-125[d]
Mercury, Total[f]	µg/L	EPA 245.1, 7470	21	83-125
Mercury, Solid[f]	mg/kg	EPA 7471	21	83-125
Molybdenum, Total	µg/L	EPA 200.7[a], 246.2, 3005, 3010, 6010[a]	25[d]	75-125[d]
Molybdenum, Solid	mg/kg	EPA 3050, 6010[a], 7480, 7481	25[d]	75-125[d]
Nickel, Total	µg/L	EPA 249.2	25[d]	75-125[d]
Nickel, Total[f]	µg/L	EPA 200.7, 3005, 3010, 6010	14	78-106
Nickel, Solid[f]	mg/kg	EPA 3050, 6010[a]	14	78-106
Potassium, Total	mg/L	EPA 258.1, 3010, 7610	14	81-109
Potassium, Total	mg/L	EPA 200.7[a], 3005, 3010, 6010[a]	19	75-113
Potassium, Solid	mg/kg	EPA 3050, 6010[a]	19	75-113
Potassium, Solid	mg/kg	EPA 3050, 7610	14	81-109

Table 5-2. Summary of Precision and Accuracy Criteria for Inorganics Analysis, Metals Analysis, and Oil and Grease, TRPH, TOX, and Radiochemical Analysis (Continued, Page 3 of 11)

Parameter	Units	Reference	Method Criterion[b,j] Precision (Max RPD)	Accuracy (Percent Recovery)
Selenium, Total[i]	µg/L	EPA 200.7[c], 3005, 3010, 6010[c]	12	85-109
Selenium, Total[i]	µg/L	EPA 270.2, 3020, 7740	29	71-129
Selenium, Solid	mg/kg	EPA 3050, 7740	29	71-129
Selenium, Solid	mg/kg	EPA 3050, 6010[c]	12	85-109
Silicon, Total	µg/L	EPA 200.7[c], 3005, 3010, 6010[c]	25	75-125
Silicon, Solid	mg/kg	EPA 3050, 6010[c]	25	75-125
Silver, Total	µg/L	EPA 272.2	24	68-116
Silver, Total[i]	µg/L	EPA 200.7, 3005, 3010, 6010	17	73-107
Silver, Solid[i]	mg/kg	EPA 3050, 6010	17	73-107
Sodium, Total	mg/L	EPA 273.1	25[d]	75-125[d]
Sodium, Total	mg/L	EPA 200.7[c], 3005, 3010, 6010[c]	15	82-112
Sodium, Solid	mg/kg	EPA 3050, 6010[c], 7770	51[e]	29-131[e]
Strontium, Total	µg/L	EPA 200.7[c], 3005, 3010, 6010[c,e]	12[f]	95-115[f]
Strontium, Solid	mg/kg	EPA 3050, 6010[c]	N/A	N/A
Thallium, Total[i]	µg/L	EPA 279.2, 3020, 7841	27	74-128
Thallium, Total[i]	µg/L	EPA 200.7[c], 3005, 3010, 6010[c]	18	75-111
Thallium, Solid[i]	mg/kg	EPA 3050, 6010[c]	18	75-111
Thallium, Solid[i]	mg/kg	EPA 3050, 7841	27	74-128
Titanium, Total	µg/L	EPA 200.7[c], 283.2[c], 3005, 3010, 6010[c,e]	24	68-116
Titanium, Solid	mg/kg	EPA 3050, 6010[c]	24	68-116
Tin, Total[i]	µg/L	EPA 200.7[c], 3005, 3010, 6010[c]	25	75-125
Tin, Solid[i]	mg/kg	EPA 3050, 6010[c]	25	75-125
Vanadium, Total[i]	µg/L	EPA 286.2, 3020, 7911	25[d]	75-125[d]
Vanadium, Total	µg/L	EPA 200.7, 3005, 3010, 6010	9	87-105
Vanadium, Solid[i]	mg/kg	EPA 3050, 6010	9	87-105
Vanadium, Solid[i]	mg/kg	EPA 3050, 7911	25[d]	75-125[d]
Zinc, Total	µg/L	EPA 289.2	25[d]	75-125[d]
Zinc, Total	µg/L	EPA 200.7, 3005, 3010, 6010	18	76-112
Zinc, Solid	mg/kg	EPA 3050, 6010	18	76-112

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Table 5-2. Summary of Precision and Accuracy Criteria for Inorganics Analysis, Metals Analysis, and Oil and Grease, TRPH, TOX, and Radiochemical Analysis (Continued, Page 4 of 11)

Parameter	Units	Reference	Method Criterion[b] Precision (Max RPD)	Accuracy (Percent Recovery)
Alkalinity, Total	mg/L-$CaCO_3$	EPA 310.1	11	88-110
COD, high-level	mg/L	HACH 8000	10	93-113
COD, low-level	mg/L	HACH 8000	10	93-113
Cyanide[i]	mg/L	EPA 335.3, 9010	18	81-117
Cyanide, Solid[i]	µg/g	EPA 9010 (Mod)	18	81-117
Moisture	% Wet Weight	ASTMD 2216-71	23	NA
Bromide	mg/L	EPA 300, 9056	6	95-107
Chloride	mg/L	EPA 325.3	8	92-108
Chloride	mg/L	EPA 300, 9056	6	95-107
Nitrogen, NO_2 + NO_3	mg/L-as N	EPA 353.2	7	90-104
Nitrogen, NO_2 + NO_3	mg/L-as N	EPA 353.2	7	90-104
Nitrogen, NO_3[b]	mg/L-as N	EPA 300, 353.2, 9200	5	95-105
Nitrogen, NO_2	mg/L-as N	EPA 300, 353.2, 9056	6	94-106
Nitrogen, NH_3 + NH_4	mg/L-as N	EPA 350.1	6	94-106
Nitrogen, TKN	mg/L-as N	EPA 351.2	23	78-124
Nitrogen, TKN, Solid	mg/kg	CE-81-1, p. 3-201, Method 1	40	57-137

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Table 5-2. Summary of Precision and Accuracy Criteria for Inorganics Analysis, Metals Analysis, and Oil and Grease, TRPH, TOX, and Radiochemical Analysis (Continued, Page 5 of 11)

Parameter	Units	Reference	Method Criterion[b] Precision (Max RPD)	Method Criterion[b] Accuracy (Percent Recovery)
Phosphorus, T	mg/L-as P	EPA 365.1	12	88-112
Phosphorus, Ortho	mg/L-as P	EPA 300, 9056	13	86-112
Phosphorus, Ortho	mg/L-as P	EPA 365.1	10	90-110
Silica	mg/L	EPA 370.1	5	92-105
Sulfate	mg/L	EPA 300, 9056	6	95-107
Sulfate	mg/L	EPA 375.4	9	89-107
Sulfide[1]	mg/L	EPA 376.2, 9030	33	60-126
Sulfide, Solid[1]	mg/kg	EPA 9030	33	60-126
Acidity, Total	mg/L-$CaCO_3$	EPA 305.1	8	92-108
BOD, 5-day	mg/L	EPA 405.1	38	60-136
BOD, 14-day	mg/L	EPA 405.1	38	60-136
Carbon, Total	mg/L	EPA 415.1, 9060	13	87-113
Carbon, TOC	mg/L	EPA 415.1, 9060	13	87-113
Carbon, TOC, Solid	g/kg	EPA 9060 (mod)	17	82-116
Carbon, TOC, Solid	% Organic Content	ASTM-D 2974[1]	20	NA
Chlorine, Free A.	mg/L	EPA 330.1	15	85-115
Chlorine, Total Residual	mg/L	EPA 330.1	15	85-115
Chromium (+6)	µg/L	EPA 7196	15	83-113
Chromium (+6), Solid	mg/kg	EPA 3060, 7196 (Mod)	15	83-113
Color, True	PCU	EPA 110.2	NA	NA
Corrosivity	mm/yr	EPA 1110, SM 2330	NA	NA

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Table 5-2. Summary of Precision and Accuracy Criteria for Inorganics Analysis, Metals Analysis, and Oil and Grease, TRPH, TOX, and Radiochemical Analysis (Continued, Page 6 of 11)

Parameter	Units	Reference	Method Criterion[b] Precision (Max RPD)	Method Criterion[b] Accuracy (Percent Recovery)
Dissolved Oxygen (DO)	mg/L	EPA 360.1	20	NA
Fluoride	mg/L	EPA 340.2	14	85-112
Fluoride	mg/L	EPA 9056	6	95-107
Hardness	mg/L-$CaCO_3$	EPA 130.2	25	85-115
Ignitability	°C	EPA 1010	NA	NA
Odor, 25°C	Thrsh No	EPA 140.1	NA	NA
Oil and Grease, Grav	mg/L	EPA 413.1	20	79-119
Oil and Grease, IR	mg/L	EPA 9073[e]	23	79-116
Oil and Grease, IR, Solid	µg/g	EPA 9071, 9073[e]	22	78-122
pH	Std Units	EPA 150.1, 9040	4	NA
pH, Solid	Std Units	EPA 9045	8	NA
Phenols	µg/L	EPA 420.2, 9066	20	73-112
Phenols, Solid	µg/g	CE-81-1, p. 3-555	25	72-122
Residue, Susp. (TSS)	mg/L	EPA 160.2	34	NA
Residue, Diss., Total (TDS) 105 Deg	mg/L	EPA 160.1	19	NA
Residue, Total (TS)	mg/L	EPA 160.3	19	NA
MBAS (foaming agents)	mg/L	EPA 425.1	17	78-112
Petroleum hydrocarbons (TRPH)	mg/L	EPA 418.1	23	76-122

Table 5-2. Summary of Precision and Accuracy Criteria for Inorganics Analysis, Metals Analysis, and Oil and Grease, TRPH, TOX, and Radiochemical Analysis (Continued, Page 7 of 11)

Parameter	Units	Reference	Method Criterion[b] Precision (Max RPD)	Accuracy (Percent Recovery)
Petroleum hydrocarbons, Solid	µg/g	EPA 9071, 9073[f]	23	76-122
Petroleum hydrocarbons, Solid	µg/g	EPA 3550, 418.1 (Mod)	34	67-135
Specific Cond.	µmhos/cm	EPA 120.1, 9050	15	NA
Temperature	°C	EPA 170.1	NA	NA
TOX	µg/L-Cl	EPA 9020A	26	73-125
TOX, Solid	µg/kg	EPA 9020A (Mod)	31	66-128
Turbidity	NTU	EPA 180.1	16	NA
TCLP	--	EPA 1311	NA	NA
Americium-241	pCi/L	ER 120, HASL G-03	25	85-115
Americium-241, Solid	pCi/g	ER 120, HASL G-03	25	85-115
Lead-210	pCi/L	EPA-EERF	25	80-120
Lead-210, Solid	pCi/g	EPA-EERF	25	80-120
Gamma, gross	pCi/L	ER 150	25	80-120
Gamma, gross, Solid	pCi/g	ER 150	25	80-120
Plutonium-238	pCi/L	ER 160, HASL G-03	25	85-115
Plutonium-238, Solid	pCi/g	ER 160, HASL G-03	25	85-115
Plutonium-239	pCi/L	ER 160, HASL G-03	25	85-115
Plutonium-239, Solid	pCi/g	ER 160, HASL G-03	25	85-115
Plutonium-240	pCi/L	ER 160, HASL G-03	25	85-115
Plutonium-240, Solid	pCi/g	ER 160, HASL G-03	25	85-115
Plutonium-241	pCi/L	ER 160, HASL G-03	25	75-125
Plutonium-241, Solid	pCi/g	ER 160, HASL G-03	25	75-125
Thorium-234	pCi/L	ER 130	25	85-115
Thorium-234, Solid	pCi/g	ER 130	25	85-115
Thorium-227	pCi/L	EPA-EERF	25	85-115
Thorium-227, Solid	pCi/g	EPA-EERF	25	85-115

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Table 5-2. Summary of Precision and Accuracy Criteria for Inorganics Analysis, Metals Analysis, and Oil and Grease, TRPH, TOX, and Radiochemical Analysis (Continued, Page 8 of 11)

Parameter	Units	Reference	Method Criterion[b] Precision (Max RPD)	Method Criterion[b] Accuracy (Percent Recovery)
Thorium-228	pCi/L	EPA-EERF	25	85-115
Thorium-228, Solid	pCi/g	EPA-EERF	25	85-115
Thorium-230	pCi/L	EPA-EERF	25	85-115
Thorium-230, Solid	pCi/g	EPA-EERF	25	85-115
Thorium-232	pCi/L	EPA-EERF	25	85-115
Thorium-232, Solid	pCi/g	EPA-EERF	25	85-115
Strontium-90	pCi/L	EML Sr-01	25	80-120
Strontium-90, Solid	pCi/g	EML Sr-01	25	80-120
Strontium 90	pCi/L	EPA 905.0	16	81-113
Strontium 89	pCi/L	EPA 905.0	14	83-111
Uranium-233	pCi/L	ER 310, HASL G-03	25	85-115
Uranium-233, Solid	pCi/g	ER 310, HASL G-03	25	85-115
Uranium-234	pCi/L	ER 310, HASL G-03	25	85-115
Uranium-234, Solid	pCi/g	ER 310, HASL G-03	25	85-115
Uranium-235	pCi/L	ER 310, HASL G-03	25	85-115
Uranium-235, Solid	pCi/g	ER 310, HASL G-03	25	85-115
Uranium-236	pCi/L	ER 310, HASL G-03	25	85-115
Uranium-236, Solid	pCi/g	ER 310, HASL G-03	25	85-115
Uranium-238	pCi/L	ER 310, HASL G-03	25	85-115
Uranium-238, Solid	pCi/g	ER 310, HASL G-03	25	85-115
Uranium, Natural	pCi/L	EPA 908.0	15	85-115
Uranium, Total	pCi/L	EPA 908.0	25	75-125
Uranium, Total, Solid	pCi/g	EPA 3050/908.0	25	75-125
Tritium	pCi/L	ER 210	25	80-120
Tritium, Solid	pCi/g	ER 210	25	80-120
Tritium	pCi/L	EPA 906.0	29	71-129
Cadmium-109	pCi/L	ER 130	25	80-120
Cadmium-109, Solid	pCi/g	ER 130	25	80-120
Cobalt-57	pCi/L	ER 130	25	80-120
Cobalt-57, Solid	pCi/g	ER 130	25	80-120

Table 5-2. Summary of Precision and Accuracy Criteria for Inorganics Analysis, Metals Analysis, Oil and Grease, TRPH, TOX, and Radiochemical Analysis (Continued, Page 9 of 11)

Parameter	Units	Reference	Method Criterion[b,d] Precision (Max RPD)	Accuracy (Percent Recovery)
Cerium-139	pCi/L	ER 130	25	80-120
Cerium-139, Solid	pCi/g	ER 130	25	80-120
Yttrium-88	pCi/L	ER 130	25	80-120
Yttrium-88, Solid	pCi/g	ER 130	25	80-120
Cobalt-60	pCi/L	ER 130	25	80-120
Cobalt-60, Solid	pCi/g	ER 130	25	80-120
Cesium-137	pCi/L	ER 130	25	85-115
Cesium-137, Solid	pCi/g	ER 130	25	80-120
Neptunium-237	pCi/L	EPA 907.0	25	85-115
Neptunium-237	pCi/g	EPA 907.0	25	85-115
Polonium-210	pCi/L	HASL Po-01	25	85-115
Polonium-210	pCi/g	HASL Po-01	25	85-115
Technetium-99	pCi/L	HASL Tc-01	25	70-130
Technetium-99	pCi/g	HASL Tc-01	25	70-130
Alpha, Gross	pCi/L	EPA 900.0, 9310	24	74-122
Alpha, Gross, Solid	pCi/g	EPA 3050 (Mod), 9310	24	74-122
Beta, Gross	pCi/L	EPA 900.0, 9310	36	58-130
Beta, Gross, Solid	pCi/g	EPA 3050 (Mod), 9310	36	58-130
Radium Alpha, Gross	pCi/L	EPA 900.1	25	75-125
Radium, 226	pCi/L	EPA 903.1, 9320	17	83-117
Radium, 226, Alpha emit	pCi/L	EPA 903.0, 9315	17	83-117
Radium, 226, Solid	pCi/g	EPA 3050 (Mod), 9320	17	83-117
Radium, 226, Alpha emit, Solid	pCi/g	EPA 3050 (Mod), 9315	17	83-117
Radium 228	pCi/L	Brooks and Blanchard	25	75-125
Radium 228	pCi/L	EPA 903.0, 9320	15	84-114
Radium 228, Solid	pCi/g	EPA 3050 (Mod), 9320	15	84-114
Radium, Total	pCi/L	EPA 903.0, 9315	45	55-145

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Table 5-2. Summary of Precision and Accuracy Criteria for Inorganics Analysis, Metals Analysis, Oil and Grease, TRPH, TOX, and Radiochemical Analysis (Continued, Page 10 of 11)

Parameter	Units	Reference	Method Criterion[b,] Precision (Max RPD)	Accuracy (Percent Recovery)
Gamma Emitters*	pCi/L	ER-130, EPA 901.1	25	NA
Gamma Emitters*	pCi/g	ER-130.	25	NA

*The gamma emitters are Beryllium -7 (Be-7), Potassium-40 (K-40), Cesium-137 (Cs-137), Lead-212 (Pb-212), Lead-214 (Pb-214), Bismuth-214 (Bi-214), Actinium-227 (Ac-227), Actinium-228 (Ac-228), Paladium-234 (Pa-234), and Thorium-234 (Th-234).

Note:
CLP = EPA Contract Laboratory Program.
MAS = million asbestos structures.
NA = not applicable.
N/A = spiking and recovery information are not available.
SOW = statement of work.
TCLP = toxicity characteristics leaching procedure.
TOX = total organic halides.
TRPH = total recoverable petroleum hydrocarbons.

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Table 5-2. Summary of Precision and Accuracy Criteria for Inorganics Analysis, Metals Analysis, and Oil and Grease, TRPH, TOX, and Radiochemical Analysis (Continued, Page 11 of 11)

References:

ASTM D2974--American Society for Testing and Materials Designation: D2974-87, July 1987.
EPA 100-400--Methods for Chemical Analyses of Water and Waste. EPA 600/4-79-20--Revised March 1983.
EPA 900--Prescribed Procedures for Measurement of Radioactivity in Drinking Water. EPA 600/4-80-032. August 1980.
EPA 1310-9073--Test Methods for Evaluating Solid Waste, SW-846. 3rd Edition (Method 9073, draft 1989: oil and grease methods exclude 7.8 and 7.10).
CE-81-1--Procedures for Handling and Chemical Analysis of Sediment and Water Samples, EPA/USACE. May 1981.
EPA CLM--Chemistry Laboratory Manual of Bottom Sediments. PB-215192. Federal Water Quality Administration. December 1969.
Hach 8000--Hach Handbook of Water Analysis, 1979. Hach Chemical Company, P.O. Box 389, Loveland, Colorado 80537.
EPA 600 M4-82-020--Interim Method for Determination of Asbestos in Bulk Insulation Samples.
NIOSH--National Institute of Occupational Safety and Health (NIOSH) Manual of Analytical Methods, 3rd Edition, Volume 1, 1984.
SM 4500-N--Standard Methods for the Examination of Water and Wastewater, 17th Edition, 1989.
EML Sr-01 = Environmental Measurements Laboratory- Health and Safety Laboratory - 300 (HASL-300), 27th Edition.
EPA-EERF = Eastern Environmental Radiation Facility Radiochemistry Procedures Manual (EPA 520/5-84-006).
ER 100-310 = Environmental Analytical Procedures- Radiochemical (ER), Los Alamos-10300-Manual, Health and Environmental Chemistry; Analytical Techniques, Data Management, and Quality Assurance.
HASL G-03 = Health and Safety Laboratory Manual, Environmental Measurements Laboratory, Department of Energy, New York, New York.

[a]The parameter may be analyzed by the referenced methodology, but it is not a control parameter for this referenced method.
[b]ESE historical data.
[c]SOP derived from referenced method is used for this unlisted analyte.
[d]Criteria from EPA CLP SOW 3/90.
[e]Data from ESE method certification.
[f]ESE performance evaluation data for EPA's Water Supply Studies.
[g]EPA Method 9073, draft method, EPA 1989, for oil and grease exclude steps 7.8 and 7.10.
[h]NO_3 (as N) by EPA 353.2 is calculation of $(NO_2 + NO_3) - (NO_2)$; also, method criteria do not apply.
[i]Percent organic carbon is calculated from the percent organic content data obtained from the ASTMD method using the equation: $\% \text{ Organic Carbon} = \frac{\% \text{ Total Organic Content}}{1.724}$
[j]Appendix IX compounds.
[k]Criteria from EPA Method 903.0--Prescribed Procedures for Measurement of Radioactivity in Drinking Water, EPA 600/4-80-032, August 1980.
[l]CLP precision and accuracy acceptance criteria for metals will be used for Los Alamos projects.

Source: ESE.

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Table 5-3. Reporting Limit Data for Metals, Inorganics, Oil and Grease, TRPH, TOX, and Radiochemical Analyses

Parameter	Reference	Reporting Limit Aqueous* (µg/L)	Reporting Limit Solid* (mg/kg)
Aluminum	EPA 200.7, 3010, 3050, 6010	73	7.3
Aluminum	EPA 202.2, 3050, 7020	5.0**	0.5**
Antimony	EPA 200.7, 3010, 3050, 6010	46	4.6
Antimony	EPA 204.2, 3050, 7041	5.0**	0.5**
Arsenic	EPA 200.7, 3010, 3050, 6010	70	7.0
Arsenic	EPA 206.2, 3020, 3050, 7060	2.3	0.23
Barium	EPA 200.7, 3010, 3050, 6010	1.4	0.14
Beryllium	EPA 200.7, 3010, 3050, 6010	2.5	0.25
Cadmium	EPA 200.7, 3010, 3050, 6010	3.9	0.39
Cadmium	EPA 213.2, 3050, 7131	0.5**	0.05**
Calcium	EPA 200.7, 3010, 3050, 6010	48	4.8
Chromium	EPA 200.7, 3010, 3050, 6010	6.3	0.63
Chromium	EPA 218.2	2.3	NA
Cobalt	EPA 200.7, 3010, 3050, 6010	17	1.7
Copper	EPA 200.7, 3010, 3050, 6010	11	1.1
Iron	EPA 200.7, 3010, 3050, 6010	28	2.8
Lead	EPA 200.7, 3010, 3050, 6010	53	5.3
Lead	EPA 239.2, 3020, 3050, 7421	1.4	0.14
Magnesium	EPA 200.7, 3010, 3050, 6010	36	3.6
Manganese	EPA 200.7, 3010, 3050, 6010	1.6	0.16
Mercury	EPA 245.1, 7470, 7471	0.2	0.02
Mercury, Low Level	EPA 245.1, 7471	0.01	0.001
Molybdenum	EPA 200.7, 3010, 3050, 6010	40	4.0
Molybdenum	EPA 3050, 7480, 7481	5.0**	0.5**

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Table 5-3. Reporting Limit Data for Metals, Inorganics, Oil and Grease, TRPH, TOX, and Radiochemical Analyses (Continued, Page 2 of 8)

Parameter	Reference	Reporting Limit Aqueous* (µg/L)	Reporting Limit Solid* (mg/kg)
Nickel	EPA 200.7, 3010, 3050, 6010	13	1.3
Nickel	EPA 3050, 3010, 6010	5.0**	0.5**
Potassium	EPA 200.7, 3010, 3050, 6010	535	53.5
Potassium	EPA 3010, 3050, 7610	5.0**	0.5**
Selenium	EPA 270.2, 6010, 200.7, 3010, 3050	101	10.1
Selenium	EPA 200.7, 3050, 7740	1.8	0.18
Silicon	EPA 200.7, 3010, 3050, 6010	50	5.0
Silver	EPA 200.7, 3010, 3050, 6010	5.8	0.58
Silver	EPA 272.2	0.16	0.016
Sodium	EPA 200.7, 3010, 3050, 6010	70	7.0
Sodium	EPA 273.1, 3050, 7770	100**	10.0**
Strontium	EPA 200.7, 6010, 3010, 3050	7.0	0.70
Thallium	EPA 200.7, 3010, 3050, 6010	110	11.0
Thallium	EPA 279.2, 3050, 7841	5.0	0.5
Tin	EPA 200.7, 3010, 3050, 6010	77	7.7
Titanium	EPA 200.7, 3005, 3010, 6010	11.4	1.14
Vanadium	EPA 200.7, 3010, 3050, 6010	7.4	0.74
Vanadium	EPA 286.2, 3050, 7911	5.0**	0.5**
Zinc	EPA 200.7, 3010, 3050, 6010	5.6	0.56
Alkalinity, Total	mg/L-$CaCO_3$	EPA 310.1	5.0***
COD, high-level	mg/L	HACH 8000	50
COD, low-level	mg/L	HACH 8000	5.0**
Cyanide	mg/L	EPA 335.3	0.005**
Cyanide, Solid	µg/g	EPA 335.3, 9010	0.25**
Moisture	% Wet Wt	ASTM-D 2216-71	0.5**
Bromide	mg/L	EPA 300, 9056	0.2**

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Table 5-3. Reporting Limit Data for Metals, Inorganics, Oil and Grease, TRPH, TOX, and Radiochemical Analyses (Continued, Page 3 of 8)

Parameter	Units	Reference	Reporting Limit
Chloride	mg/L	EPA 325.3	1.0***
Chloride	mg/L	EPA 300, 9056	0.5**
Nitrogen, NO_2 + NO_3	mg/L-as N	EPA 353.2	0.010**
Nitrogen, NO_3	mg/L-as N	EPA 300, 353.2, 9056	0.010**
Nitrogen, NO_2	mg/L-as N	EPA 300, 353.2, 9056	0.010**
Nitrogen, NH_3 + NH_4	mg/L-as N	EPA 350.1	0.05**
Nitrogen, TKN	mg/L-as N	EPA 351.2	0.10**
Nitrogen, TKN, Solid	mg/kg	CE-81-1, p. 3-201, Method 1	10**
Phosphorus, T	mg/L-as P	EPA 300, 9056	0.01**
Phosphorus, T	mg/L-as P	EPA 365.1	0.01**
Phosphorus, T Solid	mg/kg-as P	EPA 365.1	2.5**
Phosphorus, Ortho, D	mg/L-as P	EPA 365.1	0.01**
Total O-PO_4	mg/L-as P	EPA 365.1	0.01**
Silica, Diss	mg/L	EPA 370.1	2.0**
Sulfate	mg/L	EPA 375.4	5.0**
		EPA 300, 9056	0.50**
Sulfide	mg/L	EPA 376.2	0.05**
Sulfide, Solid	mg/kg	EPA 9030	0.25**
Acidity, Total	mg/L-$CaCO_3$	EPA 305.1	5**
BOD, 5-day	mg/L	EPA 405.1	1.0***
BOD, 14-day	mg/L	EPA 405.1	1.0***
Carbon, Total	mg/L	EPA 415.1, 9060	1.0**
Carbon, TOC	mg/L	EPA 415.1, 9060	1.0**
Carbon, TOC, Solid	g/kg	EPA 9060 (Mod)	360*****
Carbon, TOC, Solid	% Organic Content	ASTM- D 2974	0.1**

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Table 5-3. Reporting Limit Data for Metals, Inorganics, Oil and Grease, TRPH, TOX, and Radiochemical Analyses (Continued, Page 4 of 8)

Parameter	Units	Reference	Reporting Limit
Chlorine, Free	mg/L	EPA 330.1	0.025****
Chlorine, Total Residual	mg/L	EPA 330.1	0.025****
Chromium (+6)	µg/L	EPA 7196	2.0**
Chromium (+6), Solid	mg/kg	EPA 3060, 7196 (Mod)	0.2**
Color, true	PCU	EPA 110.2	5.0**
Fluoride	mg/L	EPA 340.2	0.10**
Fluoride	mg/L	EPA 300, 9056	0.50**
Hardness	mg/L-$CaCO_3$	EPA 130.2	1.0***
Odor, 25C	Thrsh No.	EPA 140.1	1.0***
Turbidity	NTU	EPA 180.1	0.4**
MBAS (foaming agents, surfactants)	mg/L	EPA 425.1	0.1**
Oil and Grease, IR	mg/L	EPA 413.2	0.17**
Oil and Grease, Gravimetric	mg/L	EPA 413.1	1.0**
Oil and Grease, IR, Solid	µg/g	EPA 9071, 9073	21**
Phenols	µg/L	EPA 420.2	5.0**
Phenols, Solid	µg/g	CE-81-1, p. 3-555	100***
Residue, Diss., Total (TDS) 105 Deg	mg/L	EPA 160.1	10***
Residue, Susp. (TSS)	mg/L	EPA 160.2	4****
Residue, Total (TS)	mg/L	EPA 160.3	10***
Petroleum Hydrocarbons (TRPH)	mg/L	EPA 418.1	0.17**

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Table 5-3. Reporting Limit Data for Metals, Inorganics, Oil and Grease, TRPH, TOX, and Radiochemical Analyses (Continued, Page 5 of 8)

Parameter	Units	Reference	Reporting Limit
Petroleum Hydrocarbons, Solid	µg/g	EPA 9071, 9073	21**
Petroleum Hydrocarbons, Solid	µg/g	EPA 3550, 418.1	21**
Specific Cond.	µmho/cm	EPA 120.1	10**
TOX	µg/L-Cl	EPA 9020	10**
TOX, Solid	µg/kg	EPA 9020 (Mod)	30**
Americium-241	pCi/L	EPA 120, AM-03	0.1
Americium-241, Solid	pCi/g	EPA 120, AM-03	0.01
Lead-210	pCi/L	EPA-EERF	1.0
Lead-210, Solid	pCi/g	EPA-EERF	1.0
Gamma, gross	pCi/L	EPA 150	100
Gamma, gross, Solid	pCi/g	EPA 150	2
Plutonium-238	pCi/L	ER 160	0.1
Plutonium-238, Solid	pCi/g	ER 160	0.01
Plutonium-239	pCi/L	ER 160	0.1
Plutonium-239, Solid	pCi/g	ER 160	0.01
Plutonium-240	pCi/L	ER 160	0.1
Plutonium-240, Solid	pCi/g	ER 160	0.01
Plutonium-241	pCi/L	ER 160	2.0
Plutonium-241 Solid	pCi/g	ER 160	1.0
Thorium-234	pCi/L	ER 130	20
Thorium-234, Solid	pCi/g	ER 130	1.0
Thorium-227	pCi/L	EPA-EERF	0.1
Thorium-227, Solid	pCi/g	EPA-EERF	0.1
Thorium-228	pCi/L	EPA-EERF	0.1
Thorium-228, Solid	pCi/g	EPA-EERF	0.1

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Table 5-3. Reporting Limit Data for Metals, Inorganics, Oil and Grease, TRPH, TOX, and Radiochemical Analyses (Continued, Page 6 of 8)

Parameter	Units	Reference	Reporting Limit
Thorium-230	pCi/L	EPA-EERF	0.1
Thorium-230, Solid	pCi/g	EPA-EERF	0.1
Thorium-232	pCi/L	EPA-EERF	0.1
Thorium-232, Solid	pCi/g	EPA-EERF	0.1
Strontium-90	pCi/L	EML Sr-01	1.0
Strontium-90, Solid	pCi/g	EML Sr-01	0.5
Strontium 90	pCi/L	EPA 905.0	2.0****
Strontium 89	pCi/L	EPA 905.0	2.0****
Uranium-233	pCi/L	ER 310	0.1
Uranium-233, Solid	pCi/g	ER 310	0.1
Uranium-234	pCi/L	ER 310	0.1
Uranium-234, Solid	pCi/g	ER 310	0.1
Uranium-235	pCi/L	ER 310	0.1
Uranium-235, Solid	pCi/g	ER 310	0.1
Uranium-236	pCi/L	ER 310	0.1
Uranium-236, Solid	pCi/g	ER 310	0.1
Uranium-238	pCi/L	ER 310	0.1
Uranium-238, Solid	pCi/g	ER 310	0.1
Uranium, Natural	pCi/L	EPA 908.0	1.0
Uranium, Total	pCi/L	EPA 908.0	1.0
Uranium, Total, Solid	pCi/g	EPA 3050-908.0	0.3
Tritium	pCi/L	ER 210	300
Tritium, Solid	pCi/g	ER 210	300
Tritium	pCi/L	EPA 906.0	600
Cadmium-109	pCi/L	ER 130	421
Cadmium-109, Solid	pCi/g	ER 130	14
Cobalt-57	pCi/L	ER 130	12
Cobalt-57, Solid	pCi/g	ER 130	0.5
Cerium-139	pCi/L	ER 130	10
Cerium-139, Solid	pCi/g	ER 130	0.4
Yttrium-88	pCi/L	ER 130	21
Yttrium-88, Solid	pCi/g	ER 130	0.9

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Table 5-3. Reporting Limit Data for Metals, Inorganics, Oil and Grease, TRPH, TOX, and Radiochemical Analyses(Continued, Page 7 of 8)

Parameter	Units	Reference	Reporting Limit
Cobalt-60	pCi/L	ER 130	22
Cobalt-60, Solid	pCi/g	ER 130	0.9
Cesium-137	pCi/L	ER 130	4.0
Cesium-137, Solid	pCi/g	ER 130	0.2
Neptunium-237	pCi/L	EPA 907.0	0.5
Neptunium-237	pCi/g	EPA 3050(Mod), 907.0	0.2
Polonium-210	pCi/L	HASL Po-01	1.0
Polonium-210	pCi/g	HASL Po-02	0.5
Technetium-99	pCi/L	HASL Tc-01	2.0
Technetium-99	pCi/g	HASL Tc-01	1.0
Alpha, Gross	pCi/L	EPA 900.0	1.0****
Alpha, Gross, Solid	pCi/g	EPA 3050, 9310 (Mod)	1.0****
Beta, Gross	pCi/L	EPA 900.0, 9310	3.0****
Beta, Gross, Solid	pCi/g	EPA 3050, 9310 (Mod)	3.0****
Radium Alpha, Gross	pCi/L	EPA 900.1	1.0****
Radium 226	pCi/L	EPA 903.1, 903.0, 9315, 9320	0.1****
Radium 226, Solid	pCi/g	EPA 3050, 9315, 9320 (Mod)	0.1****
Radium 226, Alpha emit	pCi/L	EPA 903.0, 9315	1.0****
Radium 226, Alpha emit, Solid	pCi/g	EPA 3050, 9315 (Mod)	1.0****
Radium 228	pCi/L	EPA 904.0, 9320	2.0****
Radium 228, Solid	pCi/g	EPA 3050, 9320 (Mod)	2.0****
Radium, Total	pCi/L	EPA 903.0, 9315	1.0****
Uranium, Natural	pCi/L	EPA 908.0	0.3****
Gamma Emitters			
Beryllium-7	pCi/L	ER 130, EPA 901.1	20
Beryllium-7	pCi/g	ER 130	140
Potassium-40	pCi/L	ER 130, EPA 901.1	43
Potassium-40	pCi/g	ER 130	300
Lead-212	pCi/L	ER 130, EPA 901.1	7.0
Lead-212	pCi/g	ER-130	50
Lead-214	pCi/L	ER-130, EPA 901.1	7.0
Lead 214	pCi/g	ER-130	50

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Table 5-3. Reporting Limit Data for Metals, Inorganics, Oil and Grease, TRPH, TOX, and Radiochemical Analyses (Continued, Page 8 of 8)

Parameter	Units	Reference	Reporting Limit
Cesium-137	pCi/L	ER 130, EPA 901.1	3.0
Cesium-137	pCi/g	ER 130	20
Bismuth-214	pCi/L	ER 130, EPA 901.1	8.0
Bismuth-214	pCi/g	ER 130	55
Actinium-227	pCi/L	ER 130, EPA 901.1	25
Actinium-227	pCi/g	ER 130	175
Actinium-228	pCi/L	ER 130, EPA 901.1	10
Actinium-228	pCi/g	ER 130	70
Paladium-234	pCi/L	ER 130, EPA 901.1	600
Paladium-234	pCi/g	ER 130	4200
Thorium-234	pCi/L	ER 130, EPA 901.1	100
Thorium-234	pCi/g	ER 130	700

Note:
µg/L = micrograms per liter.
mg/kg = milligrams per kilogram.
mg/L = milligrams per liter.
pCi/L = picocuries per liter.
pCi/g = picocuries per gram.
g/kg = grams per kilogram.
NTU = nephelometric turbidity unit.
PCU = platinum-cobalt unit.
µg/g = micrograms per gram.
µmho/cm = micromhos per centimeter.

*Based on ESE's instrument detection limit (IDL) studies unless indicated differently. The EPA Contract Laboratory Program (CLP) SOW 3/90 requirements are followed when the IDL studies are conducted.
†Based on aqueous IDL studies times a factor of 0.1 to take into account sample weight and final volume of digestate, unless indicated differently.

** Based on the lowest standard that ESE routinely uses. For solids, the reporting limits are adjusted for sample weight and final volume.
†† HACH instrument recommended detection limit. HACH Co., Box 389, Loveland, CO 80537.
*** Methods for Chemical Analyses of Water and Waste, EPA 600/4-79-020, Revised, March 1983.
††† Obtained from Standard Methods for the Examination of Water and Wastewater, 17th Edition, 1989. The reporting limits for petroleum hydrocarbon and oil and grease already take into account sample volume or sample weight and final extract volume.
**** Based on one-half of the major increments of the titration.
†††† Based on EPA's detection limits calculation procedure recommended for radiochemical analyses. (Reference: Carbon-14 in Aqueous Samples, Environmental Measurements Laboratory Manual, 1981.)
***** Based on MDL Study.

Source: ESE.

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Table 5-4. Analytes, Precision, and Accuracy Data For Trihalomethanes, EPA 501.2

Parameter	Aqueous	
	Precision (RPD)	Accuracy (% Recovery)
Chloroform	33	77-143
Bromodichloromethane	33	79-137
Dibromochloromethane	33	23-125
Bromoform	33	43-106
THMs, total*	33†	62-128†

Reference: Accuracy: EPA Method 501.2--The Analysis of Trihalomethanes in Drinking Water by Liquid/Liquid Extraction, EPA, Environmental Monitoring and Support Laboratory, Cincinnati, OH. May 15, 1979.

Precision: ESE. meets or exceeds the RPD criteria that can be calculated from the spiking and recovery information presented in the method EPA 501.2.

*Matrix spike and QC check sample compound.
†Accuracy and precision criteria are based on ESE historical data.

Source: ESE.

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Table 5-5. Reporting Limit Data for Trihalomethanes. EPA 501.2

Parameter	Reporting Limit* Aqueous (µg/L)
Chloroform	0.6
Bromodichloromethane	0.2
Dibromochloromethane	0.1
Bromoform	0.1
THMs, total	1.0

*Based on the lowest standard that ESE routinely uses, taking into account the sample volume and final extract volume.

Source: ESE.

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Table 5-6. Analytes, Precision, and Accuracy Data For EDB and DBCP, EPA 504 and Modified 504*

Parameter	Aqueous**		Solid**	
	Precision (RPD)	Accuracy (% Recovery)	Precision (RPD)	Accuracy (% Recovery)
1,2-Dibromoethane (EDB)†	20	80-120	33	65-131
DBCP (nemagon)†	30	67-127	45	54-144

*See Appendix B for Modified Method 504.
†Matrix spike and QC check sample compound.
**Accuracy and precision criteria are based on ESE historical data.

Source: ESE.

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Table 5-7. Reporting Limit Data for EDB and DBCP, EPA 504 and Modified 504

Parameter	Reporting Limits* Aqueous (µg/L)	Solid (µg/kg)
1,2-Dibromoethane (EDB)†	0.02	30
DBCP (nemagon)†	0.02	30

*Based on the lowest standard that ESE routinely uses.
The solid detection limits are expressed on a wet weight basis.
†Appendix IX compounds.

Source: ESE.

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Table 5-8. Analytes, Precision, and Accuracy Data For Organohalide Pesticides and Arochlors in Drinking Water, EPA 505

Parameter	Aqueous Precision (RPD)	Aqueous Accuracy (%Recovery)
BHC.G(lindane)*	20	71-111
Endrin*	20	79-119
Methoxychlor	63	37-163
Toxaphene	29	81-139
Alachlor	40	62-142
Heptachlor*	31	46-108
Aldrin*	29	57-115
Dieldrin*	51	36-138
Chlordane	37	68-142
PCB-1016	23	74-120
PCB-1221	29	63-121
PCB-1232	22	64-108
PCB-1242	22	74-118
PCB 1248	30	54-114
PCB-1254	35	50-120
PCB-1260	59	29-147
Atrazine	49	36-134

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Table 5-8. Analytes, Precision, and Accuracy Data For Organohalide Pesticides and Arochlors in Drinking Water. EPA 505 (Continued, Page 2 of 2)

Parameter	Aqueous Precision (RPD)	Aqueous Accuracy (%Recovery)
Chlordane, alpha	51	35-137
Chlordane, gamma	56	30-142
Chlordane	37	68-142
Heptachlor Epoxide	47	53-147
Hexachlorobenzene	41	63-145
Hexachlorocyclopentadiene	35	38-108
Simazine	25	74-125
Toxaphene	41	73-155

Reference: Accuracy: EPA Method 505--Supplement to "Methods for the Determination of Organic Compounds in Finished Drinking Water and Raw Source Water," EPA, Cincinnati, OH. September 1986. Precision: ESE, meets or exceeds the RPD criteria that can be calculated from the spiking and recovery information presented in the method (EPA 505).

*Matrix spike and QC check sample compound.

Source: ESE.

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Table 5-9. Reporting Limits Data for Organohalide Pesticides and Arochlors in Drinking Water, EPA 505

Parameter	Reporting Limit* Aqueous (µg/L)
BHC,G(lindane)	0.10
Endrin	0.10
Methoxychlor	0.20
Toxaphene	10
Alachlor	2.3‡
Heptachlor	0.10
Aldrin	0.10
Dieldrin	0.10
Chlordane	0.50
Atrazine	0.6
Chlordane, alpha	0.5
Chlordane, gamma	0.5
Chlordane	0.5
Heptachlor Epoxide	0.1
Hexachlorobenzene	0.5
Hexachlorocyclopentadiene	0.5
Simazine	1.0
Toxaphene	10.0
PCB-1016	2.0
PCB-1221	2.0
PCB-1232	2.0
PCB-1242	2.0
PCB 1248.	2.0
PCB-1254	2.0
PCB-1260	2.0

*Based on the lowest standard that ESE routinely uses, taking into account the sample volume and final extract volume. The lowest standard is chosen to be within the range of 5 to 10 times the background noise of the instrument.

‡Method detection limits listed in EPA Method 505, Analysis of Organohalide Compounds in Drinking Water (supplement to "Methods for the Determination of Organic Compounds in Drinking Water," EPA/600/4-88/039, December 1988) times ten.

Source: ESE.

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Table 5-10. Analytes, Precision, and Accuracy Data For Nitrogen and Phosphorous Containing Pesticides, EPA 507

Parameter	Aqueous Precision (RPD)	Aqueous Accuracy (% Recovery)
Alachlor	33	62-128
Ametryn	30	61-121
Atraton	33	58-124
Atrazine*	24	68-116
Bromacil	27	64-118
Butachlor	12	84-108
Butylate	63	34-160
Carboxin	12	90-114
Chlorpropham	33	60-126
Cycloate	27	62-116
Diazinon*	21	94-136
Dichlorvos	18	79-115
Diphenamid	24	69-117
Disulfoton	30	59-119
Disulfoton Sulfone	30	68-128
Disulfoton Sulfoxide	33	54-120
EPTC	27	58-112

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Table 5-10. Analytes, Precision, and Accuracy Data For Nitrogen and Phosphorous Containing Pesticides, EPA 507.
(Continued, Page 2 of 3)

Parameter	Aqueous Precision (RPD)	Aqueous Accuracy (%Recovery)
Ethoprop	15	85-115
Fenamiphos	24	66-114
Fenarimol	15	84-114
Fluridone	27	60-114
Hexazinone	21	69-111
Merphos	24	72-120
Methyl Parathion	30	68-128
Metolachlor	12	81-105
Metribuzin	15	86-116
Mevinphos	33	62-125
Molinate	54	44-152
Napropamide	15	83-119
Norflurazon	15	79-109
Pebulate	27	67-121
Prometon	27	51-105
Prometryn	24	69-117
Pronamide	30	61-121

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Table 5-10. Analytes, Precision, and Accuracy Data For Nitrogen and Phosphorous Containing Pesticides, EPA 507,
(Continued, Page 3 of 3)

Parameter	Aqueous Precision (RPD)	Aqueous Accuracy (% Recovery)
Propazine	24	68-116
Simazine*	21	79-121
Simetryn	15	84-114
Stirofos	18	80-116
Tebuthiuron	27	57-111
Terbacil	18	79-115
Terbufos	12	85-109
Terbutryn	27	67-121
Triademefon	24	69-117
Tricyclazole	21	65-107
Vernolate	18	75-111

Reference: Accuracy: EPA Method 507--Methods for the Determination of Organic Compounds in Drinking Water, EPA 600/4-88/039, December 1988.
Precision: ESE, meets or exceeds the RPD criteria that can be calculated from the spiking and recovery information presented in the method (EPA 507).

*Matrix spike and QC check sample compound.

Source: ESE.

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Table 5-11. Reporting Limit Data for Nitrogen and Phosphorus Containing Pesticides, EPA 507

Parameter	Reporting Limit* Aqueous (µg/L)
Alachlor	3.8
Ametryn	20
Ametraton	6.0
Atrazine	0.6
Bromacil	25
Butachlor	3.8
Butylate	0.3
Carboxin	6.0
Chlorpropham	5.0
Cycloate	2.5
Diazinon	0.3
Dichlorvos	0.3
Diphenamid	6
Disulfoton	0.3
Disulfoton Sulfone	38
Disulfoton Sulfoxide	3.8
EPTC	0.3
Ethoprop	1.9
Fenamiphos	10
Fenarimol	3.8

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Table 5-11. Reporting Limit Data for Nitrogen and Phosphorus Containing Pesticides, EPA 507 (Continued, Page 2 of 3)

Parameter	Reporting Limit* Aqueous (µg/L)
Fluridone	38
Hexazinone	1.2
Merphos	0.3
Methyl Parathion	25
Metolachlor	7.5
Metribuzin	1.5
Mevinphos	2.9
Molinate	1.5
Napropamide	2.5
Norflurazon	5
Pebulate	0.3
Prometon	3
Prometryn	1.9
Pronamide	7.6
Propazine	1.3
Simazine	0.75
Simetryn	2.5
Stirofos	0.6
Tebuthiuron	13
Terbacil	45

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Table 5-11. Reporting Limit Data for Nitrogen and Phosphorus Containing Pesticides, EPA 507 (Continued, Page 3 of 3)

Parameter	Reporting Limit* Aqueous (µg/L)
Terbufos	0.3[a]
Terbutryn	2.5
Triademeton	6.5
Tricyclazole	10
Vernolate	0.3

[a]Estimated detection limits listed in EPA Method 507, (Methods for the Determination of Organic Compounds in Drinking Water, EPA 600/4-88/039, December 1988) times ten.

*Based on the lowest standard that ESE routinely uses, taking into account sample volume and final extract volume. The lowest standard is chosen to be 5 to 10 times the background noise of the instrument.

Source: ESE.

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Table 5-12. Analytes, Precision, and Accuracy Data For Chlorinated Herbicides, EPA 515

Parameter	Aqueous Precision (RPD)	Aqueous Accuracy (%Recovery)
2,4-D*	30	54-120
2,4,5-TP/Silvex+der.*	30	48-126
Dalapon	30	64-118
Picloram	30	20-104
Dinoseb	30	0-113
Dicamba (banvel)*	30	54-120
Pentachlorophenol	30	30-96
2,4-DB	30	0-159
2,4,5-T	30	46-124

Reference: Accuracy: EPA Method 515--Supplement to "Methods for the Determination of Organic Compounds in Finished Drinking Water and Raw Source Water." EPA, Cincinnati, OH. September 1986.
Precision: ESE, meets or exceeds the RPD criteria that can be calculated from the spiking and recovery information presented in the EPA 515 method.

*Matrix spike and QC check sample compound.

Source: ESE.

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Table 5-13. Reporting Limit Data for Chlorinated Herbicides. EPA 515.1

Parameter	Reporting Limit* Aqueous (µg/L)
2,4-D	0.029
2,4,5-TP/Silvex + der.	0.029
Dalapon	0.029
Picloram	0.029
Dinoseb	0.029
Dicamba (banvel)	0.029
Pentachlorophenol	0.029
2,4-DB	0.029
2,4,5-T	0.029

*Based on the lowest standard that ESE routinely uses, taking into account the sample volume and final extract volume. The lowest standard is chosen to be 5 to 10 times the background noise of the instrument.

Source: ESE.

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Table 5-14. Analytes, Precision, and Accuracy Data for Volatile Organic Compounds, EPA 524.2

Parameter	Aqueous Precision (RPD%)	Aqueous Accuracy (% Recovery)
Dichlorobenzene, total	21	82-124
1,1-Dichloroethane	16	80-112
1,2-Dichloroethane	16	79-111
1,1-Dichloroethylene*	14	61-145
cis-1,2-Dichloroethene	20	81-121
trans-1,2-Dichloroethene	17	76-110
1,2-Dichloropropane	18	79-115
1,3-Dichloropropane	18	78-114
2,2-Dichloropropane	51	35-107
1,1-Dichloropropene	27	71-125
Ethylbenzene	26	73-125
Hexachlorobutadiene	20	80-120
Isopropylbenzene	23	78-124
cis-1,3-Dichloropropene	20	0-227
trans-1,3-Dichloropropene	20	17-183
p-Cymene	N/A	N/A
Naphthalene	25	79-129
Methylene chloride	16	79-111
Pentachloroethane	N/A	N/A
Styrene	21	81-123
1,1,1,2-Tetrachloroethane	20	70-110
1,1,2,2-Tetrachloroethane	19	72-110
Tetrachloroethene	20	69-109
Toluene*	13	76-125
1,2,3-Trichlorobenzene	26	83-135
1,2,4-Trichlorobenzene	25	83-135
Benzene*	11	76-127
Bromobenzene	17	83-117
Bromochloromethane	19	71-109

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Table 5-14. Analytes, Precision, and Accuracy Data for Volatile Organic Compounds, EPA 524.2 (Continued, Page 2 of 3)

Parameter	Aqueous Precision (RPD)	Aqueous Accuracy (% Recovery)
Bromodichloromethane	18	77-113
Bromoform	19	82-120
Bromomethane	25	70-120
n-Butylbenzene	23	77-123
sec-Butylbenzene	23	77-123
tert-Butylbenzene	22	80-124
Carbon tetrachloride	26	58-110
Chlorobenzene*	13	75-130
Chloroform	18	72-108
bis-2-Chloroisopropyl ether	N/A	N/A
Chloromethane	27	66-120
Chloroethane	27	62-116
2-Chlorotoluene	19	71-109
4-Chlorotoluene	25	74-124
Dibromochloromethane	21	71-113
1,2-Dibromo-3-chloropropane	60	23-143
1,2-Dibromoethane	12	90-102
Dibromomethane	17	83-117
1,2-Dichlorobenzene	19	74-112
1,3-Dichlorobenzene	21	78-120
1,4-Dichlorobenzene	19	84-122
Dichlorodifluoromethane	23	67-113
1,1,1-Trichloroethane	24	74-122
1,1,2-Trichloroethane	22	82-126
Trichloroethene*	14	71-120
Trichlorofluoromethane	24	65-113
1,2,3-Trichloropropane	43	65-151
1,2,4-Trimethylbenzene	24	75-123
1,3,5-Trimethylbenzene	22	70-114

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Table 5-14. Analytes, Precision, and Accuracy Data for Volatile Organic Compounds, EPA 524.2 (Continued, Page 3 of 3)

Parameter	Aqueous Precision (RPD)	Aqueous Accuracy (% Recovery)
Vinyl chloride	20	78-118
Xylene, total	23	81-127
Dichlorobenzene-D4†	NA	87-107
4-Bromofluorobenzene†	NA	86-115

Reference: Accuracy: EPA Method 524.2--Methods for the Determination of Organic Compounds in Drinking Water, EPA 600/4-88/039, December 1988 and CLP SOW 7/87 for the controlling analytes.
Precision: ESE (meets or exceeds the RPD criteria that can be calculated from the spiking and recovery information presented in the EPA method 524.2) and CLP SOW 7/87 for controlling analytes.

Note: N/A = spiking and recovery information is not available.
NA = not applicable.

*Matrix spike and QC check sample compound.
†Surrogate: the surrogate is added to all environmental samples and quality control samples.

Source: ESE.

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Table 5-15. Reporting Limit Data for Volatile Organic Compounds, EPA 524.2

Parameter	Reporting Limit* Aqueous (µg/L)
Dichlorobenzene, total	1.0
1,1-Dichloroethane	1.0
1,2-Dichloroethane	1.0
1,1-Dichloroethylene	1.0
cis-1,2-Dichloroethene	1.0
trans-1,2-Dichloroethene	1.0
1,2-Dichloropropane	1.0
1,3-Dichloropropane	1.0
2,2-Dichloropropane	1.0
1,1-Dichloropropene	1.0
Ethylbenzene	1.0
Hexachlorobutadiene	1.0
Isopropylbenzene	1.0
cis-1,3-Dichloropropene	1.0
trans-1,3-Dichloropropene	1.0
p-Cymene	1.0
Naphthalene	1.0
Methylene chloride	1.0
Pentachloroethane	1.0
Styrene	1.0
1,1,1,2-Tetrachloroethane	1.0
1,1,2,2-Tetrachloroethane	1.0
Tetrachloroethene	1.0
Toluene	1.0
1,2,3-Trichlorobenzene	1.0
1,2,4-Trichlorobenzene	1.0
Benzene	1.0
Bromobenzene	1.0
Bromochloromethane	1.0
Bromodichloromethane	1.0
Bromoform	1.0

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Table 5-15. Reporting Limit Data for Volatile Organic Compounds, EPA 524.2 (Continued, Page 2 of 3)

Parameter	Reporting Limit* Aqueous (µg/L)
Bromomethane	1.0
n-Butylbenzene	1.0
sec-Butylbenzene	1.0
tert-Butylbenzene	1.0
Carbon tetrachloride	1.0
Chlorobenzene	1.0
Chloroform	1.0
bis-2-Chloroisopropyl ether	1.0
Chloromethane	1.0
Chloroethane	1.0
2-Chlorotoluene	1.0
4-Chlorotoluene	1.0
Dibromochloromethane	1.0
1,2-Dibromo-3-chloropropane	3.0
1,2-Dibromoethane	3.0
Dibromomethane	1.0
1,2-Dichlorobenzene	1.0
1,3-Dichlorobenzene	1.0
1,4-Dichlorobenzene	1.0
Dichlorodifluoromethane	1.0
1,1,1-Trichloroethane	1.0
1,1,2-Trichloroethane	1.0
Trichloroethene	1.0
Trichlorofluoromethane	1.0
1,2,3-Trichloropropane	1.0
1,2,4-Trimethylbenzene	1.0
1,3,5-Trimethylbenzene	1.0
Vinyl chloride	1.0
Xylene, total	1.0

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Table 5-15. Reporting Limit Data for Volatile Organic Compounds. EPA 524.2 (Continued. Page 3 of 3)

The reporting limits are based on the concentration that can be detected reliably according to ESE's past database and analytical experience performing
volatile organic analyses by gas chromatography/mass spectrometry.

Source: ESE.

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Table 5-16. Analytes, Precision, and Accuracy Data For N-Methyl Carbamoxyloximes and N-Methyl Carbamates, EPA 531.1

Parameter	Aqueous Precision (RPD)	Aqueous Accuracy (%Recovery)
Aldicarb*	17[1]	83-117[1]
Aldicarb sulfone	20	84-120
Aldicarb sulfoxide	20	72-128
Carbaryl*	26[1]	63-115[1]
Carbofuran*	18[1]	81-117[1]
3-Hydroxycarbofuran	20	36-162
Methomyl	20	64-115
Oxamyl	20	34-148

Reference: Accuracy: EPA Method 531.1--Supplement to "Methods for the Determination of Organic Compounds in Finished Drinking Water and Raw Source Water," EPA, Cincinnati, OH, September 1986.
Precision: ESE, meets or exceeds the RPD criteria that can be calculated from the spiking and recovery information presented in the method (EPA 531.1).

*Matrix spike and QC check sample compound.
[1]Accuracy and precision criteria are based on ESE historical data.

Source: ESE.

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Table 5-17. Reporting Limit Data for N-Methyl Carbamoxyloximes and N-Methyl Carbamates, EPA 531.1

Parameter	Reporting Limit* Aqueous (µg/L)
Aldicarb	2.0
Aldicarb sulfone	2.0
Aldicarb sulfoxide	2.0
Carbaryl	2.0
Carbofuran	2.0
3-Hydroxycarbofuran	2.0
Methomyl	2.0
Oxamyl	2.0

*Based on the lowest standard that ESE routinely uses. The lowest standard is chosen to be within the range of 5 to 10 times the background noise of the instrument.

Source: ESE.

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Table 5-18. Analytes, Precision, and Accuracy Data for Purgeable Halocarbons, EPA 601 and SW 5030/801C

Parameter	Aqueous Precision (RPD	Aqueous Accuracy (% Recovery)	Solid Precision (RPD)	Solid Accuracy (% Recovery)
Bromodichloromethane	20	42-172	30	42-172
Bromoform	20	13-159	30	13-159
Bromomethane	20	0-144	30	0-144
Carbon tetrachloride	20	43-143	30	43-143
Chlorobenzene*	43[1]	51-137[1]	50	38-150
Chloroethane	20	46-137	30	46-137
2-Chloroethylvinylether	20	14-186	30	14-186
Chloroform	20	49-133	30	49-133
Chloromethane	20	0-193	30	0-193
Dibromochloromethane	20	24-191	30	24-191
Dichlorobenzene,tot.	20	42-143	30	42-143
1,1-Dichloroethane	20	47-132	30	47-132
1,2-Dichloroethane	20	51-147	30	51-147
1,1-Dichloroethylene*	38[1]	51-127[1]	30	28-167
Trans-1,2-dichloroethene	20	38-155	30	38-155
1,2-Dichloropropane	20	44-156	30	44-156
cis-1,3-Dichloropropene	20	22-178	30	22-178

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Table 5-18. Analytes, Precision, and Accuracy Data for Purgeable Halocarbons, EPA 601 and SW 5030/8010 (Continued, Page 2 of 2)

Parameter	Aqueous Precision (RPD	Aqueous Accuracy (% Recovery)	Solid Precision (RPD)	Solid Accuracy (% Recovery)
Trans-1,3-dichloropropene	20	22-178	30	22-178
Methylene chloride	20	25-162	30	25-162
1,1,2,2-Tetrachloroethane	20	8-184	30	8-184
Tetrachloroethene	20	26-162	30	26-162
1,1,1-Trichloroethane	20	41-138	30	41-138
1,1,2-Trichloroethane	20	39-136	30	39-136
Trichloroethene*	40†	54-134††	30	35-146
Trichlorofluoromethane	20	21-156	30	21-156
Vinyl chloride	20	28-163	30	28-163
Freon 113**	33	73-139	N/A	N/A

Reference: Accuracy: EPA Method SW 8010--Test Methods for Evaluating Solid Wastes, EPA-SW-846 3rd Edition, September 1986. Precision: ESE, meets or exceeds the RPD criteria that can be calculated from the spiking and recovery information presented in the method (SW 8010).

Note: N/A - spiking and recovery information are not available.

*Matrix spike and QC check sample compound.
†Accuracy and precision criteria are based on ESE historical data.
**Accuracy and precision criteria are based on ESE validation study (see Appendix U).
Source: ESE.

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Table 5-19. Reporting Limit Data for Purgeable Halocarbons, EPA 601 and SW 5030/8010

Parameter	Reporting Limits Aqueous* (µg/L)	Reporting Limits Solid* (µg/kg)
Bromodichloromethane**	1.0	100
Bromoform**	1.0	100
Bromomethane**	1.0	100
Carbon tetrachloride**	1.0	100
Chlorobenzene**	1.0	100
Chloroethane**	1.0	100
2-Chloroethylvinylether**	1.0	100
Chloroform**	1.0	100
Chloromethane**	1.0	100
Dibromochloromethane**	1.0	100
Dichlorobenzene,tot.**	1.0	100
1,1-Dichloroethane**	1.0	100
1,2-Dichloroethane**	1.0	100
1,1-Dichloroethylene**	1.0	100
Trans-1,2-dichloroethene**	1.0	100
1,2-Dichloropropane**	1.0	100
cis-1,3-Dichloropropene	1.0	100
Trans-1,3-dichloropropene	1.0	100
Methylene chloride**	1.0	100
1,1,2,2-Tetrachloroethane**	1.0	100
Dichlorodifluoromethane	1.0	100

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Table 5-19. Reporting Limit Data for Purgeable Halocarbons, EPA 601 and SW 5030/8010 (Continued, Page 2 of 2)

Parameter	Reporting Limits Aqueous* (µg/L)	Solid⁻ (µg/kg)
Tetrachloroethene**	1.0	100
1,1,1-Trichloroethane**	1.0	100
1,1,2-Trichloroethane**	1.0	100
Trichloroethene**	1.0	100
Trichlorofluoromethane**	1.0	100
Vinyl chloride**	1.0	100
Freon 113	1.0	N/A

Note: N/A = Reporting limit information not available.

*Based on the lowest standard that ESE routinely uses.
⁻Based on the lowest standard that ESE routinely uses times a factor of 100. The solid reporting limits are expressed on a wet weight basis.
**Appendix IX compounds.

Source: ESE.

Table 5-20. Analytes, Precision, and Accuracy Data for Purgeable Aromatics, EPA 602 and SW 5030/8020

Parameter	Aqueous Precision (RPD	Aqueous Accuracy (%Recovery)	Solid Precision (RPD)	Solid Accuracy (%Recovery)
Benzene*,†,**	44*	44-132*	28*	74-130
Chlorobenzene†,**	20	55-135	30	55-135
Dichlorobenzene,total†,**	20	42-143	30	42-143
Ethylbenzene†,**	20	32-160	30	32-160
Toluene*,†,**	40*	47-127*	26*	75-127*
Xylenes, total†,**	23*	80-126*	27*	74-128*
MTBE	N/A	N/A	N/A	N/A
Total VOA (BTEX)	42*	46-130*	27*	75-129*

Reference: Accuracy: EPA Method SW 8020--Test Methods for Evaluating Solid Wastes, EPA-SW-846 3rd Edition, September 1986.
Precision: ESE, meets or exceeds the RPD criteria that can be calculated from the spiking and recovery information presented in the method (SW 8020).

Note: Total VOA (BTEX) is calculated and defined as the arithmetic sum of the concentrations of benzene, toluene, ethylbenzene, and total xylenes.
MTBE = methyl tert-butyl ether.
N/A = spiking and recovery information are not available.

* Matrix spike and QC check sample compound.
† Accuracy and precision criteria are based on ESE historical data.
** Appendix IX compounds.

Source: ESE.

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Table 5-21. Reporting Limit for Purgeable Aromatics, EPA 602 and SW 5030/8020

Parameter	Reporting Limits Aqueous* (µg/L)	Solid† (µg/kg)
Benzene	1.0	100
Chlorobenzene	1.0	100
Dichlorobenzene, total	1.0	100
Ethylbenzene	1.0	100
Toluene	1.0	100
Xylenes, total	1.0	100
MTBE	N/A	N/A
Total VOA (BTEX)	5.0	500

Note: N/A = Reporting limit information not available.

*Based on the lowest standard that ESE routinely uses.
†Based on the lowest standard that ESE routinely uses times a factor of 100. The solid reporting limits are expressed on a wet weight basis.

Source: ESE.

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Table 5-22. Analytes, Precision, and Accuracy Data for Phenols, EPA 604 and SW 3510/3520/3540/3550/8040

Parameter	Aqueous Precision (RPD	Aqueous Accuracy (%Recovery)	Solid Precision (RPD)	Solid Accuracy (%Recovery)
4-Chloro-3-methylphenol[*,1]	30	39-130	50	39-130
2-Chlorophenol[*,1]	30	38-126	50	38-126
2,4-Dichlorophenol[1]	30	44-119	50	44-119
2,4-Dimethylphenol[1]	30	24-118	50	24-118
2,4-Dinitrophenol[1]	30	12-145	50	12-145
2-Methyl-4,6-dinitrophenol[1]	30	30-136	50	30-136
2-Nitrophenol[1]	30	43-117	50	43-117
4-Nitrophenol[1]	30	13-110	50	13-110
Pentachlorophenol[*,1]	30	36-134	50	36-134
Phenol[*,1]	30	23-108	50	23-108
2,4,6-Trichlorophenol[1]	30	53-119	50	53-119

Reference: Accuracy: EPA Method SW 8040--Test Methods for Evaluating Solid Wastes, EPA-SW-846 3rd Edition, September 1986.
Precision: ESE; meets or exceeds the RPD criteria that can be calculated from the spiking and recovery information presented in the method (SW 8040).

*Matrix spike and QC check sample compound.
[1]Appendix IX compounds.

Source: ESE.

Table 5-23. Reporting Limit Data for Phenols, EPA 604 and SW 3510/3520/3540/3550/8040

Parameter	Reporting Limits Aqueous* (µg/L)	Solid† (µg/kg)
4-Chloro-3-methylphenol	5.0	500
2-Chlorophenol	5.0	500
2,4-Dichlorophenol	5.0	500
2,4-Dimethylphenol	5.0	500
2,4-Dinitrophenol	20.0	2,000
2-Methyl-4,6-dinitrophenol	5.0	500
2-Nitrophenol	5.0	500
4-Nitrophenol	25.0	2,500
Pentachlorophenol	10.0	1,000
Phenol	5.0	500
2,4,6-Trichlorophenol	6.0	600

*Based on the lowest standard that ESE routinely uses taking into account the sample volume and final extract volume. The lowest standard is chosen to be within the range of 5 to 10 times the background noise of the instrument.

†Based on the lowest standard that ESE routinely uses, taking into account sample weight and final extract volume. The lowest standard is chosen to be within the range of 5 to 10 times the background noise of the instrument. The solid detection limits are expressed on a wet weight basis.

Source: ESE.

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Table 5-24. Analytes, Precision, and Accuracy Data for Benzidines, EPA 605

Parameter	Aqueous Precision (RPD)	Aqueous Accuracy (% Recovery)
Benzidine*	30	31-92
3,3'-Dichlorobenzidine	30	35-93

Reference: Accuracy: EPA Method 605--Test Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater, EPA 600/4-82-057, July 1982.
Precision: ESE: meets or exceeds the RPD criteria that can be calculated from the spiking and recovery information presented in the method (EPA 605).

*Matrix spike and QC check sample compound.

Source: ESE.

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Table 5-25. Reporting Limit Data for Benzidines, EPA 605

Parameter	Reporting Limit* Aqueous (µg/L)
Benzidine	1.0
3,3'-Dichlorobenzidine	1.5

*Ten times the method detection limit listed in Table 1 of EPA Method 605.

Source: ESE.

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Table 5-26. Analytes, Precision, and Accuracy Data for Phthalate Esters, EPA 606 and SW 35010/3520/3540/3550/8060

Parameter	Aqueous Precision (RPD	Aqueous Accuracy (%Recovery)	Solid Precision (RPD)	Solid Accuracy (%Recovery)
bis(2-Ethylhexyl)phthalate	30	0-158	50	0-158
Butyl benzyl phthalate	30	30-136	50	30-136
di-n-Butylphthalate*	30	23-136	50	23-136
Diethylphthalate*	30	0-149	50	0-149
Dimethylpthalate	30	0-156	50	0-156
di-n-Octylphthalate*	30	0-114	50	0-114

Reference: Accuracy: EPA Method SW 8060--Test Methods for Evaluating Solid Wastes. EPA-SW-846 3rd Edition. September 1986.
Precision: ESE: meets or exceeds the RPD criteria that can be calculated from the spiking and recovery information presented in the method (SW 8060).

*Matrix spike and QC check sample compound.

Source: ESE.

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Table 5-27. Reporting Limit Data for Phthalate Esters. EPA 606 and SW 3510/3520/3540/3550/8060

Parameter	Reporting Limits Aqueous* (µg/L)	Solid† (µg/kg)
bis(2-Ethylhexyl)phthlate	0.15	25
Butyl benzylphthalate	0.15	25
di-n-Butylphthalate	0.15	25
Diethylphthalate	0.15	25
Dimethylpthalate	0.15	25
di-n-Octylphthalate	0.30	50

*Based on the lowest standard that ESE routinely uses, taking into account the sample volume and final extract volume. The lowest standard is chosen to be within the range of 5 to 10 times the background noise of the instrument.

†Based on the lowest standard that ESE routinely uses, taking into account the sample weight and final extract volume. The lowest standard is chosen to be within the range of 5 to 10 times the background noise of the instrument. the solid reporting limits are expressed on a wet weight basis.

Source: ESE.

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Table 5-28. Analytes, Precision, and Accuracy Data for Organochlorine Pesticides and PCBs, EPA 608/617 and SW 3510/3520/3540/3550/8080

Parameter	Aqueous Precision (RPD	Aqueous Accuracy (% Recovery)	Solid Precision (RPD)	Solid Accuracy (% Recovery)
Aldrin[a,f]	45[b]	37-127[b]	40[b]	53-133[b]
BHC.A[a]	30	37-134	50	37-134
BHC.B	30	17-147	50	17-147
BHC.D	30	19-140	50	19-140
BHC.G(lindane)[a,f]	51[f]	43-145[f]	42[f]	45-129[f]
Chlordane[f]	30	45-119	50	45-119
DDD.PP[a,f]	30	31-141	50	31-141
DDE.PP[a,f]	30	30-145	50	30-145
DDT.PP[a,f]	53	46-152[f]	59[f]	37-155[b]
Dieldrin[a,f]	43	56-142[f]	47	46-140[f]
Endosulfan.A[a]	30	45-153	50	45-153
Endosulfan.B	30	0-202	50	0-202
Endosulfan sulfate[f]	30	26-144	50	26-144
Endrin[a,f]	60[b]	35-155[f]	37[b]	52-126[b]
Endrin aldehyde[f]	40[c]	58-138[c]	53[c]	56-162[c]
Heptachlor[a,f]	38[f]	48-124[b]	59[b]	30-148[b]
Heptachlor epoxide[f]	30	37-142	50	37-142

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Table 5-28. Analytes, Precision, and Accuracy Data for Organochlorine Pesticides and PCBs, EPA 608/617 and SW 3510/3520/3540/3550/8080 (Continued, Page 2 of 3)

Parameter	Aqueous Precision (RPD	Aqueous Accuracy (% Recovery)	Solid Precision (RPD)	Solid Accuracy (% Recovery)
Methoxychlor[f]	44[e]	78-162[e]	53[e]	61-167[e]
Toxaphene[f]	30	41-126	50	41-126
Isodrin[a,b]	27[e]	74-128[e]	10[e]	97-117[b]
Kepone[a,b]	44[b]	26-114[b]	30[b]	98-158[b]
Metolachlor	28[e]	74-130[e]	24[e]	62-110[e]
Kelthane (Dicofol)	20[e]	47-87[e]	19[e]	40-78[e]
PCB-1016[d,h]	30	50-114	50	50-114
PCB-1221[h]	30	15-178	50	15-178
PCB-1232[h]	30	10-215	50	10-215
PCB-1242[h]	30	39-150	50	39-150
PCB 1248[h]	30	38-158	50	38-158
PCB-1254[f]	30	29-131	50	29-131
PCB-1260[d,f]	30	8-127	50	8-127
Dibutylchlorendate[c]	NA	46-146[b]	NA	32-156[b]
Tetrachloro-m-xylene	NA	60-150	NA	60-150
Decachlorobiphenyl	NA	60-150	NA	60-150

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Table 5-28. Analytes, Precision, and Accuracy Data for Organochlorine Pesticides and PCBs, EPA 608/617 and SW 3510/3520/3540/3550/8080 (Continued, Page 3 of 3)

Reference: Accuracy: EPA Method SW 8080 and CLP SOW 7/87 for the controlling analytes.
Precision: ESE and CLP SOW 7/87 for the controlling analytes.

Note: NA = not applicable.

[a]Matrix spike and QC check sample compound. For Los Alamos project CLP SOW 12/90 precision and accuracy acceptance criteria will be used.
[b]Accuracy and precision criteria are based on ESE historical data and method detection limit data.
[c]Surrogate; the surrogate is added to all environmental samples and quality control samples.
[d]PCB 1016 and PCB 1260 are only used as matrix spike and QCC samples compounds when using EPA 608/8080 to evaluate PCBs only.
[e]Accuracy and precision data are from ESE method certification.
[f]Based on validation studies performed by ESE (see Appendices D and E).
[g]Appendix IX compounds.
[h]This compound is not included in EPA's parameter lists for Methods 608, 617, and 8080; however, it can be analyzed by EPA method 8080 and is reported if specifically requested by the client (see Appendices L and M for method validation data).
[i]See Appendices L and M for method validation data of isodrin by EPA Method 8050.

Source: ESE.

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Table 5-29. Reporting Limit Data for Organochlorine Pesticides and PCBs, EPA 608 and SW 3510/3520/3540/3550/8080

Parameter	Reporting Limits Aqueous* (µg/L)	Reporting Limits Solid† (µg/kg)
Aldrin	0.006	3
BHC.A	0.006	3
BHC.B	0.006	3
BHC.D	0.006	3
BHC.G(lindane)	0.006	3
Chlordane	0.030	20
DDD.PP	0.006	3
DDE.PP'	0.006	3
DDT.PP'	0.006	3
Dieldrin	0.006	3
Endosulfan.A	0.006	3
Endosulfan.B	0.006	3
Endosulfan sulfate	0.006	3
Endrin	0.006	3
Endrin aldehyde	0.006	3
Heptachlor	0.006	3
Heptachlor epoxide	0.006	3
Methoxychlor	0.006	3
Toxaphene	0.6	300
PCB-1016	0.12	60
Mirex	0.2	100
Trifluralin	0.1	50
PCNB	0.02	1

Table 5-29. Reporting Limit Data for Organochlorine Pesticides and PCBs, EPA 608 and SW 3510/3520/3540/3550/8080
(Continued, Page 2 of 2)

Parameter	Reporting Limits Aqueous* (µg/L)	Solid† (µg/kg)
Isodrin	0.05	8
Kepone	0.10	50
Metolachlor	0.06	10
Kelthane (Dicofol)	0.06	10
PCB-1221	0.12	60
PCB-1232	0.12	60
PCB-1242	0.12	60
PCB-1248	0.12	60
PCB-1254	0.12	60
PCB-1260	0.12	60

*Based on the lowest standard that ESE routinely uses, taking into account the sample volume and final extract volume. The lowest standard is chosen to be within the range of 5 to 10 times the background noise of the instrument.

†Based on the lowest standard that ESE routinely uses, taking into account sample weight and final extract volume. The lowest standard is chosen to be within the range of 5 to 10 times the background noise of the instrument. The solid reporting limits are expressed on a wet weight basis.

Source: ESE.

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Table 5-30. Analytes, Precision, and Accuracy Data for Polynuclear Aromatic Hydrocarbons, EPA 610 and SW 3510/3520/3540/3550/8310

Parameter	Aqueous Precision (RPD	Aqueous Accuracy (% Recovery)	Solid Precision (RPD)	Solid Accuracy (% Recovery)
Acenaphthene[*,**]	30[†]	49-109[†]	50	0-124
Acenaphthylene[*,**]	25[†]	53-103[†]	50	0-139
Anthracene[*,**]	40[†]	44-124[†]	50	0-126
Benzo(a)anthracene[**]	30	12-135	50	12-135
Benzo(a)pyrene[*,**]	38[†]	45-121[†]	62[†]	27-151[†]
Benzo(b)fluoranthene[**]	30	6-150	50	6-150
Benzo(ghi)perylene[**]	30	0-116	50	0-116
Benzo(k)fluoranthene[*,**]	41[†]	41-123[†]	55[†]	22-132[†]
Chrysene[**]	30	0-199	50	0-199
Dibenyl(a,h)anthracene[**]	30	0-110[†]	50	0-110
Fluoranthene[**]	30	14-123	50	14-123
Fluorene[*,**]	35[†]	40-110[†]	49[†]	25-123[†]
Indeno(1,2,3-cd)pyrene[**]	30	0-116	50	0-116
Naphthalene[*,**]	48[†]	21-117[†]	50	0-122
Phenanthrene[*,**]	32[†]	52-116[†]	50	0-155
Pyrene[**]	30	0-140	50	0-140
1-Methylnaphthalene[**]	37[†]	23-97[†]	37[†]	23-97[†]

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Table 5-30. Analytes, Precision, and Accuracy Data for Polynuclear Aromatic Hydrocarbons, EPA 610 and SW 3510/3520/3540/3550/8310 (Continued. Page 2 of 2)

Parameter	Aqueous Precision (RPD	Aqueous Accuracy (%Recovery)	Solid Precision (RPD)	Solid Accuracy (%Recovery)
2-Methylnaphthalene**	37[1]	23-97[1]	37[1]	23-97[1]
Methylnaphthalene, total	37[1]	23-97[1]	75[1]	10-160[1]

Reference: Accuracy: EPA Method SW 8310--Test Methods for Evaluating Solid Wastes. EPA-SW-846 3rd Edition. September 1986.
Precision: ESE: meets or exceeds the RPD criteria that can be calculated from the spiking and recovery information presented in the method (SW 8310).

*Matrix spike and QC check sample compound.
[1]Accuracy and precision criteria are based on ESE historical data.
**Appendix IX compounds.

Source: ESE.

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Table 5-31. Reporting Limit Data for Polynuclear Aromatic Hydrocarbons, EPA 610 and SW 3510/3520/3540/3550/8310

Parameter	Reporting Limits Aqueous* (µg/L)	Reporting Limits Solid† (µg/kg)
Acenaphthene	2.5	84
Acenaphthylene	1.5	44
Anthracene	0.095	3.5
Benzo(a)anthracene	0.002	0.05
Benzo(a)pyrene	0.004	0.4
Benzo(b)fluoranthene	0.001	0.02
Benzo(ghi)perylene	0.006	0.20
Benzo(k)fluoranthene	0.001	0.01
Chrysene	0.03	0.80
Dibenzo(a,h)anthracene	0.004	0.07
Fluoranthene	0.003	0.08
Fluorene	0.25	10
Indeno(1,2,3-cd)pyrene	0.004	0.15
Naphthalene	0.90	23
Phenanthrene	0.07	4.0
Pyrene	0.03	0.6
1-Methylnaphthalene	1.5	45
2-Methylnaphthalene	1.2	36
Methylnaphthalene, total	3.0	63

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Table 5-31. Reporting Limit Data for Polynuclear Aromatic Hydrocarbons, EPA 610 and SW 3510/3520/3540/3550/8310
(Continued, Page 2 of 2)

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*Based on the lowest standard that ESE routinely uses, taking into account the sample volume and final extract volume. The lowest standard is chosen to be within the range of 5 to 10 times the background noise of the instrument.

†Based on the lowest standard that ESE routinely uses, taking into account sample weight and final extract volume. The solid reporting limits are expressed on a wet weight basis. The lowest standard is chosen to be within the range of 5 to 10 times the background noise of the instrument.

Source: ESE.

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Table 5-32. Analytes, Precision, and Accuracy Data for Chlorinated Herbicides, EPA 615 and SW 8150.

Parameter	Aqueous Precision (RPD	Aqueous Accuracy (% Recovery)	Solid Precision (RPD)	Solid Accuracy (% Recovery)
2.4-D*,**	55'	9-119'	48'	35-131'
2.4-DB	30	84-102	50	84-102
2.4.5-T**	30	67-103	50	67-103
2,4,5-TP/Silvex'der.*,**	51'	33-135'	41'	61-143'
Dicamba (banvel)*	47'	21-115'	32'	57-121'
Dalapon	30	42-90	50	42-90
Dichlorprop	30	91-103	50	91-103
Dinoseb**	30	74-100	50	74-100
MCPA	30	86-110	50	86-110
MCPP	30	82-106	50	82-106

Reference: Accuracy: EPA Method SW 8150--Test Methods for Evaluating Solid Wastes, EPA-SW-846 3rd Edition. September 1986.
Precision: ESE: meets or exceeds the RPD criteria that can be calculated from the spiking and recovery information presented in the method (SW 8150).

*Matrix spike and QC check sample compound.
'Accuracy and precision criteria are based on ESE historical data.
**Appendix IX compounds.

Source: ESE.

Table 5-33. Reporting Limit Data for Chlorinated Herbicides, EPA 615 and SW 8150

Parameter	Reporting Limits Aqueous* (µg/L)	Reporting Limits Solid† (µg/kg)
2,4-D	0.03	3
2,4-DB	0.03	3
2,4,5-T	0.03	3
2,4,5-TP/Silvex + der.	0.03	3
Dicamba (banvel)	0.03	3
Dalapon	0.03	3
Dichlorprop	0.03	3
Dinoseb	0.03	3
MCPA	0.60	50
MCPP	0.60	50

*Based on the lowest standard that ESE routinely uses, taking into account the sample volume and final extract volume. The lowest standard is chosen to be within the range of 5 to 10 times the background noise of the instrument.

†Based on the lowest standard that ESE routinely uses, taking into account sample weight and final extract volume. The lowest standard is chosen to be within the range of 5 to 10 times the background noise of the instrument. The solid reporting limits are expressed on a wet weight basis.

Source: ESE.

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Table 5-34. Analytes, Precision, and Accuracy Data for Organophosphorous Pesticides, EPA 622/614 and SW 3510/3520/3540/3550/8140

Parameter	Aqueous		Solid	
	Precision (RPD	Accuracy (%Recovery)	Precision (RPD)	Accuracy (%Recovery)
Bolstar	30	46-84	50	46-84
Chlorpyrifos	30	82-115	50	82-115
Coumaphos	30	71-147	50	71-147
Demeton	30	36-99	50	36-99
Diazinon*	47**	61-155**	294**	75-133**
Dichlorvos	30	49-95	50	49-95
Disulfoton**	30	55-109	50	55-109
Ethoprop	30	88-113	50	88-113
Fenthion	30	9-128	50	9-128
Fensulfothion	30	43-145	50	43-145
Guthion (methylazinphos)*	51**	44-146**	51**	59-161**
Malathion*	35**	64-134**	31**	66-128**
Merphos	30	97-144	50	97-144
Mevinphos	30	33-80	50	33-80
Naled	30	54-102	50	54-102
Ethylparathion*,**	43**	65-151**	49**	61-159**
Methylparathion**	30	80-112	50	80-112

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Table 5-34. Analytes, Precision, and Accuracy Data for Organophosphorous Pesticides, EPA 622/614 and SW 3510/3520/3540/3550/8140 (Continued, Page 2 of 3)

Parameter	Aqueous Precision (RPD	Aqueous Accuracy (% Recovery)	Solid Precision (RPD)	Solid Accuracy (% Recovery)
Phorate**	30	36-89	50	36-89
Ronnel	30	82-116	50	82-116
Stirofos	30	48-84	50	48-84
Tokuthion	30	44-85	50	44-85
Trichloronate	30	49-161	50	49-161
Alachlor***	N/A	N/A	19	112-150
Metribuzin***	N/A	N/A	31	62-124
EPTC*	25	70-120	6	97-109
Butylate*	23	61-107	7	95-114
Pebulate*	22	69-113	11	89-111
Vernolate*	23	69-115	8	94-110
Atrazine*	32	79-143	32	61-125
Terbufos*	16	79-111	15	88-118
Hexazinone*	50	56-150	50	40-140
Famphur**	61	52-174	40	69-149
0.0.0-Triethyl Phosphorothioate**,***,***	44	41-129	14	107-135
Sulfotepp**,***,***	28	50-106	13	99-125

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Table 5-34. Analytes, Precision, and Accuracy Data for Organophosphorous Pesticides, EPA 622/614 and SW 3510/3520/3540/3550/8140 (Continued, Page 3 of 3)

Parameter	Aqueous Precision (RPD	Aqueous Accuracy (%Recovery)	Solid Precision (RPD)	Solid Accuracy (%Recovery)
Thionazin[††,***,†††]	22	64-108	13	92-118

Reference: Accuracy: EPA Method SW 8140--Test Methods for Evaluating Solid Wastes. EPA-SW-846 3rd Edition. September 1986.
Precision: ESE: meets or exceeds the RPD criteria that can be calculated from the spiking and recovery information presented in the method (SW 8140).

Note: N/A = spiking and recovery information not available.

*Matrix spike and QC check sample compound.
*Precision and accuracy criteria are based on validation studies performed by ESE (see Appendices F and G).
**Accuracy and precision criteria are based on ESE historical data.
††Appendix IX compounds.
***Precision and accuracy criteria are based on validation studies performed by ESE (see Appendices J and K).
†††This compound is not included in EPA's parameter list for Method 614, 622, and 8140; however, it can be analyzed by EPA Method 8140 and is reported if specifically requested by the client.

Source: ESE.

Table 5-35. Reporting Limit Data for Organophosphorous Pesticides, EPA 614/622 and SW 3510/3520/3540/3550/8140

Parameter	Reporting Limits Aqueous* (µg/L)	Solid† (µg/kg)
Bolstar	0.3	50
Chlorpyrifos	0.3	50
Coumaphos	3.0	500
Demeton	0.3	50
Diazinon	0.3	50
Dichlorvos	0.3	50
Disulfoton	0.3	50
Ethoprop	0.3	50
Fenthion	0.3	50
Fensulfothion	1.5	250
Guthion (methylazinphos)	3.0	500
Malathion	0.3	50
Merphos	0.3	50
Mevinphos	0.3	50
Naled	1.5	250
Ethylparathion	0.3	50
Methylparathion	0.3	50
Phorate	0.3	50
Ronnel	0.3	50
Stirofos	0.6	100

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Table 5-35. Reporting Limit Data for Organophosphorous Pesticides, EPA 614/622 and SW 3510/3520/3540/3550/8140 (Continued, Page 2 of 2)

Parameter	Reporting Limits Aqueous* (µg/L)	Solid† (µg/kg)
Tokuthion	0.3	50
Trichloronate	0.3	50
Alachlor	N/A	100
Metribuzin	N/A	250
EPTC	0.3	50
Butylate	0.3	50
Pebulate	0.3	50
Vernolate	0.3	50
Atrazine	0.6	100
Terbufos	0.3	50
Hexazinone	1.5	250
Famphur	0.5	70
0,0,0-Triethyl Phosphorothioate	0.5	70
Sulfotepp	0.5	70
Thionazin	0.5	70

Note: N/A = reporting limit not available.

*Based on the lowest standard that ESE routinely uses, taking into account the sample volume and final extract volume. The lowest standard is chosen to be within the range of 5 to 10 times the background noise of the instrument.

†Based on the lowest standard that ESE routinely uses, taking into account sample weight and final extract volume. The lowest standard is chosen to be within the range of 5 to 10 times the background noise of the instrument. The solid reporting limits are expressed on a wet weight basis.

Source: ESE.

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Table 5-36. Analytes, Precision, and Accuracy Data for Volatile Organic Compounds, EPA 624 and SW 5030/8240/8260

Parameter	Aqueous Precision (RPD	Aqueous Accuracy (% Recovery)	Solid Precision (RPD)	Solid Accuracy (% Recovery)
Acetone[d]	53[c]	56-162[c]	53[c]	52-158[c]
Benzene[a,d]	11	76-127	21	66-142
Bromodichloromethane[d]	20	35-155	30	35-155
Bromoform[d]	20	45-169	30	45-169
Bromomethane[d]	20	0-242	30	0-242
Carbon tetrachloride[d]	20	70-140	30	70-140
Chlorobenzene[a,d]	13	75-130	21	60-133
Chlorobenzene[c]	9	89-107	37	76-150
2-Chloroethylvinyl ether	20	0-305	30	0-305
Chloroform[d]	20	51-138	30	51-138
Chloromethane[d]	20	0-273	30	0-273
Dibromochloromethane[d]	20	53-149	30	53-149
Dichlorobenzene,tot.[d]	20	18-190	30	18-190
1,1-Dichloroethane[d]	20	59-155	30	59-155
1,2-Dichloroethane[d]	20	49-155	30	49-155
1,1-Dichloroethylene[a,d]	14	61-145	22	59-172
trans-1,2-Dichloroethene[d]	20	54-156	30	54-156

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Table 5-36. Analytes, Precision, and Accuracy Data for Volatile Organic Compounds, EPA 624 and SW 5030/8240/8260 (Continued, Page 2 of 4)

Parameter	Aqueous Precision (RPD	Aqueous Accuracy (% Recovery)	Solid Precision (RPD)	Solid Accuracy (% Recovery)
1,2-Dichloropropane[d]	20	0-210	30	0-210
cis-1,3-Dichloropropene[d]	20	0-227	30	0-227
trans-1,3-Dichloropropene[d]	20	17-183	30	17-183
Methylene chloride[d]	20	0-221	30	0-221
Methyl ethyl ketone[d] (MEK)	42[e]	61-145[e]	79[e]	12-172[e]
Methyl isobutyl ketone[d] (MIBK)	46[e]	50-146[e]	41[e]	78-160[e]
Styrene[d]	13[e]	91-117[e]	13[e]	89-115[e]
1,1,2,2-Tetrachloroethane[d]	20	46-157	30	46-157
Tetrachloroethene[d]	20	64-148	30	64-148
Toluene[a,d]	13	76-125	21	59-139
1,1,1-Trichloroethane[d]	20	52-162	30	52-162
1,1,2-Trichloroethane[d]	20	52-150	30	52-150
Trichloroethene[a,d]	14	71-120	24	62-137
Trichlorofluoromethane[d]	20	17-181	30	17-181
Vinyl chloride[d]	20	0-251	30	0-251
Xylene, total[d]	26[e]	83-135[e]	46[e]	52-144[e]
Toluene-D8[f]	NA	88-110	NA	81-117

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Table 5-36. Analytes, Precision, and Accuracy Data for Volatile Organic Compounds, EPA 624 and SW 5030/8240/8260 (Continued, Page 3 of 4)

Parameter	Aqueous Precision (RPD	Aqueous Accuracy (% Recovery)	Solid Precision (RPD)	Solid Accuracy (% Recovery)
4-Bromofluorobenzene[f]	NA	86-115	NA	74-121
1,2-Dichloroethane-D4[f]	NA	76-114	NA	70-121
Dibromofluoromethane[f]	NA	86-118	NA	80-120
Acetonitrile[d,f]	48[e]	120-216[e]	49[e]	91-188[e]
Acrolein[d]	21[e]	75-117[e]	55[e]	6-116[e]
Acrylonitrile[d]	52[e]	25-129[e]	10[e]	72-92[e]
Carbon Disulfide[d]	14[e]	81-109[e]	47[e]	97-191[e]
Chloroprene[d,f]	8[e]	93-109[e]	8[e]	89-105[e]
3-Chloropropene[d,f]	8[e]	87-103[e]	21[e]	116-158[e]
Dichlorodifluoromethane[d]	32[e]	67-131[e]	50[e]	37-137[e]
trans- 1,4-Dichloro-2-butene[d,f]	20[e]	69-109[e]	63[e]	0-121[e]
1,4-Dioxane[d,f]	8[e]	95-111[e]	31[e]	83-145[e]
Ethyl Methacrylate[d]	12[e]	112-136[e]	19[e]	100-138[e]
2-Hexanone[d]	41[e]	100-182[e]	98[e]	45-241[e]
Iodomethane[d]	15[e]	84-114[e]	53[e]	61-167[e]
Isobutanol[d,f]	31[e]	71-133[e]	37[e]	74-148[e]
Methacrylonitrile[d,f]	19[e]	52-90[e]	11[e]	87-109[e]

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Table 5-36. Analytes, Precision, and Accuracy Data for Volatile Organic Compounds, EPA 624 and SW 5030/8240/8260 (Continued, Page 4 of 4)

Parameter	Aqueous Precision (RPD	Aqueous Accuracy (% Recovery)	Solid Precision (RPD)	Solid Accuracy (% Recovery)
Methyl Methacrylate[d,f]	16[e]	66-98[e]	33[e]	56-122[e]
Pentachloroethane[d,f]	36[e]	48-120[e]	59[e]	20-138[e]
Propionitrile[d,g]	53[e]	114-220[e]	60[e]	25-145[e]
1,1,1,2-Tetrachloroethane[d,g]	6[e]	88-100[e]	23[e]	75-121[e]
1,2,3-Trichloropropane[d]	8[e]	121-137[e]	27[e]	89-143[e]
Vinyl Acetate[d]	37[e]	57-131[e]	33[e]	46-110[e]

Reference: Accuracy: EPA Method SW 8240--Test Methods for Evaluating Solid Wastes, EPA-SW-846 3rd Edition, September 1986 and CLP SOW 7/87 for the controlling analytes. Precision: ESE (meets or exceeds the RPD criteria that can be calculated from the spiking and recovery information presented in the method (SW 8240) and CLP SOW 7/87 for controlling analytes.

Note: NA = not applicable.

[a]Matrix spike and QC check sample compound.
[b]Surrogate; the surrogate is added to all environmental samples and quality control samples.
[c]Accuracy and precision data are from ESE method certification.
[d]Appendix IX compounds.
[e]Accuracy and precision data are from ESE method detection limit study.
[f]This compound is not included in EPA's lists of compounds (EPA 624, 8240, and 8260) methods; however, it can be analyzed by this method and is reported if specifically requested by the client (see Appendix N for method validation data).
[g]This surrogate will be used only for Los Alamos project.
Source: ESE.

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Table 5-37. Reporting Limit Data for Volatile Organic Compounds, EPA 624 and SW 5030/8240/8260

Parameter	Reporting Limits Aqueous* (µg/L)	Reporting Limits Solid** (µg/kg)
Acetone	9.0	5500'
Benzene	2.2	220'
Bromodichloromethane	2.2	110'
Bromoform	2.6	235'
Bromomethane	3.5	290'
Carbon tetrachloride	2.6	220
Chlorobenzene	1.4	300'
Chloroethane	8.2	410
2-Chloroethylvinyl ether	3.1	500'
Chloroform	2.5	110
Chloromethane	4.4	310
Dibromochloromethane	2.3	155'
Dichlorobenzene, total	4.0	350'
1,1-Dichloroethane	2.5	235'
1,2-Dichloroethane	2.5	170
1,1-Dichloroethylene	3.2	200
trans-1,2-Dichloroethene	2.4	120
1,2-Dichloropropane	2.0	300'
cis-1,3-Dichloropropene	2.0	250'
trans-1,3-Dichloropropene	1.6	320'
Ethylbenzene	1.3	360'

Table 5-37. Reporting Limit Data for Volatile Organic Compounds. EPA 624 and SW 5030/8240/8260 (Continued. Page 2 of 3)

Parameter	Reporting Limits Aqueous* (µg/L)	Reporting Limits Solid** (µg/kg)
Methylene chloride	6.4	1000†
Methyl ethyl ketone	10	2400†
Methyl isobutyl ketone	12	600†
Styrene	0.5	355†
1,1,2,2-Tetrachloroethane	1.5	205†
Tetrachloroethene	1.9	205†
Toluene	1.7	300†
1,1,1-Trichloroethane	2.5	190†
1,1,2-Trichloroethane	2.8	250†
Trichloroethene	3.0	120
Trichlorofluoromethane	4.6	300
Vinyl chloride	4.6	360
Xylene, total	3.72	770
Acetonitrile	200	50
Acrolein	100	100
Acrylonitrile	100 †	100†
Carbon Disulfide	5 †	5†
Chloroprene	10†	10 †
3-Chloropropene	50†	50†
Dichlorodifluoromethane	100†	200†
trans-1,4-Dichloro-2-butene	50†	5†
1,4-Dioxane	200†	200†

Table 5-37. Reporting Limit Data for Volatile Organic Compounds, EPA 624 and SW 5030/8240/8260 (Continued, Page 3 of 3)

Parameter	Reporting Limits Aqueous* (µg/L)	Reporting Limits Solid** (µg/kg)
Ethyl Methacrylate	5†	5†
2-Hexanone	10†	10†
Iodomethane	5†	5†
Isobutanol	1000†	1000†
Methacrylonitrile	5†	5†
Methyl Methacrylate	5†	5†
Pentachloroethane	5†	5†
Propionitrile	5†	5†
1,1,1,2-Tetrachloroethane	5†	5†
1,2,3-Trichloropropane	5†	5†
Vinyl Acetate	10†	10†

*Based on ESE's MDL studies conducted according to 40 CFR 136 Appendix B protocols, except for total dichlorobenzene, methyl ethyl ketone, and methyl isobutyl ketone. These compounds are difficult to analyze and do not respond well, therefore, the reporting limits have been adjusted to a concentration that is detected more reliably.

†Based on ESE's MDL studies but the reporting limits have been adjusted to a concentration that is detected more reliably.

**Based on ESE's MDL studies conducted according to 40 CFR 136 Appendix B protocols.

Source: ESE.

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Table 5-38. Analytes, Precision, and Accuracy Data for Semivolatile Orlganic Compounds, EPA 625 and SW 3510/3520/3540/3550/8270

Parameter	Aqueous Precision (RPD	Aqueous Accuracy (% Recovery)	Solid Precision (RPD)	Solid Accuracy (% Recovery)
Acenaphthene[a,f]	31	46-118	19	31-137
Acenaphthylene[f]	30	33-146	50	33-146
Anthracene[f]	30	27-133	50	27-133
Benzidine	27[c]	4-58[c]	27[c]	4-58[c]
Benzo(a)anthracene[f]	30	33-143	30	33-143
Benzo(b)fluoranthene[f]	30	24-159	50	24-159
Benzo(k)fluoranthene[f]	30	11-162	50	11-162
Benzo(a)pyrene[f]	30	17-163	50	17-163
Benzo(ghi)perylene[f]	30	0-219	50	0-219
Benzyl alcohol[f]	14	65-93	43	17-103
Butylbenzylphthalate[f]	30	0-152	50	0-152
bis(2-Chloroethyl)ether[f]	30	12-158	50	12-158
bis(2-Chloroethoxy)-methane[f]	30	33-184	50	33-184
bis(2-Ethylhexyl)-phthalate[f]	30	8-158	50	8-158
bis(2-Chloroisopropyl)-ether[f]	30	36-166	50	36-166

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Table 5-38. Analytes, Precision, and Accuracy Data for Semivolatile Orlganic Compounds, EPA 625 and SW 3510/3520/3540/3550/8270 (Continued, Page 2 of 9)

Parameter	Aqueous Precision (RPD	Aqueous Accuracy (% Recovery)	Solid Precision (RPD)	Solid Accuracy (% Recovery)
4-Bromophenylphenyl-ether[f]	30	53-127	50	53-127
Chloronaphthalene[f]	30	60-118	50	60-118
2-Chlorophenol[a,f]	40	27-123	50	25-102
4-Chloro-3-methylphenol[a,f]	42	23-97	33	26-103
4-Chlorophenylphenylether[f]	30	25-158	50	25-158
Chrysene[f]	30	17-168	50	17-168
Dibenzo(a,h)anthracene[f]	30	0-227	50	0-227
di-n-Butylphthalate[f]	30	1-118	50	1-118
1,3-Dichlorobenzene[f]	30	0-172	50	0-172
1,2-Dichlorobenzene[f]	30	32-129	50	32-129
1,4-Dichlorobenzene[a,f]	28	36-97	27	28-104
3,3'-Dichlorobenzidine[f]	30	0-262	50	0-262
2,4-Dichlorophenol[f]	30	39-135	50	39-135
Diethylphthalate[f]	30	0-114	50	0-114
2,4-Dimethylphenol[f]	30	32-119	50	32-119
Dimethylpthalate[f]	30	0-112	50	0-112

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Table 5-38. Analytes, Precision, and Accuracy Data for Semivolatile Organic Compounds, EPA 625 and SW 3510/3520/3540/3550/8270 (Continued, Page 3 of 9)

Parameter	Aqueous Precision (RPD	Aqueous Accuracy (% Recovery)	Solid Precision (RPD)	Solid Accuracy (% Recovery)
2,4-Dinitrophenol[f]	30	0-191	50	0-191
2,4-Dinitrotoluene[a,f]	38	24-96	47	28-89
2,6-Dinitrotoluene[f]	30	50-158	50	50-158
di-n-Octylphthalate[f]	30	4-146	50	4-146
Fluoranthene[f]	30	26-137	50	26-137
Fluorene[f]	30	59-121	50	59-121
Hexachlorobenzene[f]	30	0-152	50	0-152
Hexachlorobutadiene[f]	30	24-116	50	24-116
Hexachlorocyclopentadiene[f]	36[e]	9-81[e]	18[e]	33-69[e]
Hexachloroethane[f]	30	40-113	50	40-113
Indeno(1,2,3-cd)pyrene[f]	30	0-171	50	0-171
Isophorone[f]	30	21-196	50	21-196
2-Methyl-4,6-dinitrophenol[f]	30	0-181	50	0-181
Naphthalene[f]	30	21-133	50	21-133
Nitrobenzene[f]	30	30-180	50	35-180
2-Nitrophenol[f]	30	29-182	50	29-182

Table 5-38. Analytes, Precision, and Accuracy Data for Semivolatile Organic Compounds, EPA 625 and SW 3510/3520/3540/3550/8270 (Continued, Page 4 of 9)

Parameter	Aqueous Precision (RPD	Aqueous Accuracy (%Recovery)	Solid Precision (RPD)	Solid Accuracy (%Recovery)
4-Nitrophenol[a,d]	50	10-80	50	11-114
n-Nitrosodimethylamine[f]	16[e]	55-87[e]	16[e]	55-87[e]
n-Nitrosodi-n-propylamine[a,f]	38	41-116	38	41-126
n-Nitrosodiphenylamine[f]	30	85-115	50	85-115
Pentachlorophenol[a,f]	50	9-103	47	17-109
Phenanthrene[f]	30	54-120	50	54-120
Phenol[a,d]	42	12-89	35	26-90
Pyrene[a,f]	31	26-127	36	35-142
1,2,4-Trichlorobenzene[a,f]	28	39-98	23	38-107
2,4,6-Trichlorophenol[f]	30	37-144	50	37-144
2,3,7,8-TCDD	N/A	N/A	N/A	N/A
Acetophenone[f]	8[e]	73-89[e]	12[e]	70-94[e]
2-Acetylaminofluorene[f,g]	10[e]	23-43[e]	11[e]	15-37[e]
4-Aminobiphenyl[f]	14[e]	44-72[e]	48[e]	5-101[e]
Aniline[f]	34[e]	51-119[e]	74[e]	6-154[e]

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Table 5-38. Analytes, Precision, and Accuracy Data for Semivolatile Organic Compounds, EPA 625 and SW 3510/3520/3540/3550/8270 (Continued, Page 5 of 9)

Parameter	Aqueous Precision (RPD	Aqueous Accuracy (%Recovery)	Solid Precision (RPD)	Solid Accuracy (%Recovery)
Aramite[f,g]	11[e]	14-36[e]	16[e]	10-42[e]
1,4-Benzenediamine[f,g]	24[e]	51-99[e]	N/A	N/A[e]
p-Benzoquinone[f,g]	29[e]	19-77[e]	49[e]	64-162[e]
4-Chloroaniline[f]	20[e]	48-87[e]	89[e]	0-149[e]
Chlorobenzilate[f,g]	12[e]	66-90[e]	14[e]	63-91[e]
1-Chloronaphthalene[f]	8[e]	70-86[e]	12[e]	75-99[e]
Dibenz(a,j)acridine[f]	19[e]	69-107[e]	40[e]	0-58[e]
Diallate[f,g]	8[e]	41-57[e]	8[e]	43-59[e]
Dibenzofuran[f]	14[e]	71-99[e]	42[e]	40-124[e]
2,6-Dichlorophenol[f]	10[e]	69-89[e]	14[e]	62-90[e]
Dimethoate[f,g]	22[e]	48-92[e]	13[e]	59-85[e]
p-(Dimethylamino)azo-benzene[f]	8[e]	57-73[e]	15[e]	46-76[e]
7,12-Dimethylbenz(a) anthracene[f]	12[e]	43-67[e]	11[e]	12-34[e]
3,3-Dimethylbenzidine[f,g]	24[e]	11-59[e]	15[e]	3-33[e]
m-Dinitrobenzene[f,g]	8[e]	32-48[e]	15[e]	38-68[e]

Table 5-38. Analytes, Precision, and Accuracy Data for Semivolatile Orlganic Compounds, EPA 625 and SW 3510/3520/3540/3550/8270 (Continued. Page 6 of 9)

Parameter	Aqueous Precision (RPD	Aqueous Accuracy (% Recovery)	Solid Precision (RPD)	Solid Accuracy (% Recovery)
Diphenylamine[f]	7[c]	68-82[c]	14[c]	56-85[c]
Diphenylhydrazine[f]	8[c]	67-83[c]	16[c]	65-97[c]
Ethylmethanesulfonate[f]	7[c]	72-86[c]	16[c]	64-96[c]
a,a-Dimethylphenylamine[f]	93[c]	0-149[c]	N/A	N/A
Hexachlorophene[f,e]	N/A	N/A	N/A	N/A
Hexachloropropene[f,e]	17[c]	45-79[c]	14[c]	54-82[c]
Isosafrole[f,e]	12[c]	64-88[c]	28[c]	50-106[c]
Methapyrilene[f,e]	66[c]	15-147[c]	N/A	N/A
3-Methylcholanthrene[f]	14[c]	41-69[c]	42[c]	9-93[c]
Methylmethanesulfonate[f,e]	36[c]	35-107[c]	24[c]	52-100[c]
2-Methylnaphthalene[f]	17[c]	55-89[c]	28[c]	49-105[c]
2-Methylphenol(o-Cresol)[f]	20[c]	58-98[c]	43[c]	17-103[c]
3-Methylphenol(m-Cresol)[f,e]	8[c]	64-80[c]	10[c]	59-79[c]
4-Methylphenol(p-Cresol)[f]	15[c]	72-102[c]	36[c]	28-100[c]
1-Naphthylamine[f]	23[c]	26-72[c]	7[c]	6-20[c]
2-Naphthylamine[f]	13[c]	35-61[c]	15[c]	22-52[c]

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Table 5-38. Analytes, Precision, and Accuracy Data for Semivolatile Orlganic Compounds, EPA 625 and SW 3510/3520/3540/3550/8270 (Continued, Page 7 of 9)

Parameter	Aqueous Precision (RPD	Aqueous Accuracy (%Recovery)	Solid Precision (RPD)	Solid Accuracy (%Recovery)
2-Nitroaniline[f]	13[e]	45-71[e]	18[e]	48-84[e]
3-Nitroaniline[f]	25[e]	28-78[e]	22[e]	40-84[e]
4-Nitroaniline[f]	33[e]	63-91[e]	45[e]	75-165[e]
N-Nitrosodiethylamine[f,g]	13[e]	63-91[e]	14[e]	67-95[e]
N-Nitroso-di-n-butylamine[f]	20[e]	66-106[e]	17[e]	71-105[e]
N-Nitrosomethyl-ethylamine[f,g]	79[e]	13-171[e]	23[e]	29-75[e]
N-Nitrosomorpholine[f,g]	18[e]	54-90[e]	22[e]	49-93[e]
N-Nitrosopiperidine[f]	15[e]	64-94[e]	17[e]	57-91[e]
Nitroquinoline-1-oxide[f,g]	57[e]	0-113[e]	53[e]	11-117[e]
Nitrosopyrrolidine[f,g]	25[e]	52-102[e]	16[e]	53-85[e]
1,4-Naphthoquinone[f,g]	5[e]	44-54[e]	16[e]	45-77[e]
5-Nitro-o-toluidine[f,g]	23[e]	25-71[e]	10[e]	41-61[e]
Pentachlorobenzene[f]	7[e]	70-84[e]	10[e]	77-97[e]
Pentachloronitrobenzene[f]	44[e]	0-81[e]	36[e]	15-87[e]
Phenacetin[f]	10[e]	65-85[e]	16[e]	56-88[e]

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Table 5-38. Analytes, Precision, and Accuracy Data for Semivolatile Orlganic Compounds, EPA 625 and SW 3510/3520/3540/3550/8270 (Continued, Page 8 of 9)

Parameter	Aqueous Precision (RPD	Aqueous Accuracy (% Recovery)	Solid Precision (RPD)	Solid Accuracy (% Recovery)
2-Picoline[f]	53[e]	0-98[e]	44[e]	0-70[e]
Pronamide[f]	15[e]	51-81[e]	13[e]	57-83[e]
Pyridine[f,g]	79[e]	5-163[e]	40[e]	0-45[e]
Resorcinol[f,g]	15[e]	11-41[e]	55[e]	17-127[e]
1,2,4,5-Tetrachloro-benzene[f]	13[e]	61-87[e]	10[e]	77-97[e]
2,3,4,6-Tetrachlorophenol[f]	16[e]	48-80[e]	12[e]	48-72[e]
2,4,5-Trichlorophenol[f]	17[e]	58-92[e]	44[e]	11-99[e]
1,3,5-Trinitrobenzene[f,g]	18[e]	39-75[e]	38[e]	0-75[e]
o-Toluidine[f,g]	8[e]	71-87[e]	13[e]	60-86[e]
Safrole[f,g]	25[e]	50-100[e]	23[e]	58-104[e]
Nitrobenzene-D5[h]	NA	35-114	NA	23-120[e]
2-Fluorobiphenyl[h]	NA	43-116	NA	30-115[e]
p-Terphenyl-D4[h]	NA	33-141	NA	18-137
Phenol-D6[h]	NA	10-94	NA	24-113
2-Fluorophenol[h]	NA	21-100	NA	25-121
2,4,6-Tribromophenol[h]	NA	10-123	NA	19-122

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Table 5-38. Analytes, Precision, and Accuracy Data for Semivolatile Orlganic Compounds, EPA 625 and SW 3510/3520/3540/3550/8270 (Continued, Page 9 of 9)

Reference: Accuracy: EPA Method SW 8270--Test Methods for Evaluating Solid Wastes, EPA-SW-846 3rd Edition, September 1986 and CLP SOW 7/87 for the controlling analytes.
Precision: ESE (meets or exceeds the RPD criteria that can be calculated from the spiking and recovery information presented in the method (SW 8270) and CLP SOW7/87 for controlling analytes.

Note: N/A = spiking and recovery information is not available.
NA = not applicable.

[a]Matrix spike and QC check sample compound.
[b]Surrogate: the surrogate is added to all environmental samples and quality control samples.
[c]Accuracy and precision criteria taken from Methods for the Determination of Organic Compounds in Drinking Water, EPA/600/4-88/039, December, 1988.
[d]Accuracy and precision data are from ESE method certification.
[e]Accuracy and precision data are from ESE method detection limit study.
[f]Appendix IX compounds.
[g]This compound is not included in EPA's list of compounds (EPA 625, 8270) for these methods; however, it can be analyzed by this method and is reported if specifically requested by the client (see Appendix O for method validation data).

Source: ESE.

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Table 5-39. Reporting Limit Data for Semivolatile Organic Compounds, EPA 625 and SW 3510/3520/3540/3550/8270

Parameter	Reporting Limits Aqueous* (µg/L)	Reporting Limits Solid* (µg/kg)
Acenaphthene	1.0	70
Acenaphthylene	1.0	70
Anthracene	1.0	70
Benzidine	5.0	2,000
Benzo(a)anthracene	1.0	100
Benzo(b)fluoranthene	1.5	100
Benzo(k)fluoranthene	1.5	100
Benzo(a)pyrene	2.0	140
Benzo(ghi)perylene	2.5	160
Benzyl alcohol	2.0	140
Butylbenzylphthalate	1.5	100
bis(2-Chloroethyl)ether	1.5	70
bis(2-Chloroethoxy)methane	1.0	70
bis(2-Ethylhexyl)phthalate	2.0	100
bis(2-Chloroisopropyl)ether	1.0	70
4-Bromophenylphenylether	1.0	140
2-Chloronaphthalene	1.0	70
2-Chlorophenol	2.0	140
4-Chloro-3-methylphenol	1.5	140
4-Chlorophenylphenylether	1.0	100
Chrysene	2.5	100
Dibenzo(a,h)anthracene	2.5	160

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Table 5-39. Reporting Limit Data for Semivolatile Organic Compounds, EPA 625 and SW 3510/3520/3540/3550/8270
(Continued, Page 2 of 7)

Parameter	Reporting Limits Aqueous* (µg/L)	Reporting Limits Solid* (µg/kg)
Dioxin (scan)	1.0	70
di-n-Butylphthalate	1.0	70
1,3-Dichlorobenzene	1.0	70
1,2-Dichlorobenzene	1.0	70
1,4-Dichlorobenzene	1.0	70
3,3'-Dichlorobenzidine	5.0	500
2,4-Dichlorophenol	2.0	140
Diethylphthalate	1.0	70
2,4-Dimethylphenol	2.0	500
Dimethylpthalate	2.0	70
2,4-Dinitrophenol	30.0	1,300
2,4-Dinitrotoluene	2.0	140
2,6-Dinitrotoluene	2.0	140
di-n-Octylphthalate	2.4	140
Fluoranthene	1.0	70
Fluorene	1.0	70
Hexachlorobenzene	2.0	100
Hexachlorobutadiene	2.0	140
Hexachlorocyclopentadiene	2.0	1000
Hexachloroethane	1.5	100
Indeno(1,2,3-cd)pyrene	2.5	160

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Table 5-39. Reporting Limit Data for Semivolatile Organic Compounds, EPA 625 and SW 3510/3520/3540/3550/8270
(Continued, Page 3 of 7)

Parameter	Reporting Limits Aqueous* (µg/L)	Reporting Limits Solid* (µg/kg)
Isophorone	1.0	160
2-Methyl-4,6-dinitrophenol	20.0	1,000
Naphthalene	1.0	70
Nitrobenzene	1.0	70
2-Nitrophenol	2.0	140
4-Nitrophenol	10.0	500
n-Nitrosodimethylamine	1.0	100
n-Nitrosodi-n-propylamine	1.0	100
n-Nitrosodiphenylamine	1.0	70
Pentachlorophenol	10.0	500
Phenanthrene	1.0	70
Phenol	2.0	140
Pyrene	1.0	70
1,2,4-Trichlorobenzene	1.0	100
2,4,6-Trichlorophenol	4.5	300
2-Methylnaphthalene	1.0	100
2,3,7,8-TCDD	1.0	70

Table 5-39. Reporting Limit Data for Semivolatile Organic Compounds, EPA 625 and SW 3510/3520/3540/3550/8270
(Continued, Page 4 of 7)

Parameter	Reporting Limits Aqueous* (µg/L)	Reporting Limits Solid* (µg/kg)
Acetophenone	1.0	70
2-Acetylaminofluorene	1.5	140
4-Aminobiphenyl	1.0	70
Aniline	2.0	300
Aramite	2.0	140
1,4-Benzenediamine	30.0	ND
p-Benzoquinone	1.0	70
4-Chloroaniline	2.0	300
Chlorobenzilate	1.0	70
1-Chloronaphthalene	1.0	70
Dibenz(a,j)acridine	1.0	1200
Diallate	1.0	70
Dibenzofuran	1.0	120
2,6-Dichlorophenol	1.0	70
Dimethoate	1.0	70
p-Dimethylaminoazobenzene	1.0	70

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Table 5-39. Reporting Limit Data for Semivolatile Organic Compounds, EPA 625 and SW 3510/3520/3540/3550/8270
(Continued, Page 5 of 7)

Parameter	Reporting Limits Aqueous* (µg/L)	Reporting Limits Solid* (µg/kg)
7,12-Dimethylbenz(a)anthracene	1.0	140
3,3-Dimethylbenzidine	1.5	450
m-Dinitrobenzene	1.5	200
Diphenylamine	1.0	70
Diphenylhydrazine	1.0	70
Ethylmethanesulfonate	1.0	70
a,a-Dimethylphenethylamine	11.0	ND
Hexachlorophene	ND	ND
Hexachloropropene	4.0	140
Isosafrole	1.0	70
Methapyrilene	55.0	ND
3-Methylcholanthrene	1.0	100
Methylmethanesulfonate	1.0	70
2-Methynaphthalene	1.0	100
2-Methylphenol (o-Cresol)	2.0	140
3-Methylphenol (m-Cresol)	1.0	70
4-Methylphenol (p-Cresol)	2.0	140

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Table 5-39. Reporting Limit Data for Semivolatile Organic Compounds, EPA 625 and SW 3510/3520/3540/3550/8270
(Continued, Page 6 of 7)

Parameter	Reporting Limits Aqueous* (µg/L)	Reporting Limits Solid* (µg/kg)
1-Naphthylamine	1.0	330
2-Naphthylamine	1.0	70
2-Nitroaniline	2.0	300
3-Nitroaniline	2.0	300
4-Nitroaniline	2.0	400
N-Nitrosodiethylamine	1.0	70
N-Nitrosomethylethylamine	2.0	70
N-Nitroso-di-n-butylamine	1.0	70
N-Nitrosomorpholine	1.0	70
N-Nitrosopiperidine	1.0	70
4-Nitroquinoline-1-oxide	26.0	1,600
Nitrosopyrrolidine	1.0	70
1,4-Naphthoquinone	1.0	70
5-Nitro-o-toluidine	1.0	70
Pentachlorobenzene	1.0	70
Pentachloronitrobenzene	2.0	100

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Table 5-39. Reporting Limit Data for Semivolatile Organic Compounds, EPA 625 and SW 3510/3520/3540/3550/8270
(Continued. Page 7 of 7)

Parameter	Reporting Limits Aqueous* (µg/L)	Reporting Limits Solid* (µg/kg)
Phenacetin	1.0	70
2-Picoline	2.0	330
Pronamide	1.0	70
Pyridine	10.0	300
Resorcinol	10.0	420
1,2,4,5-Tetrachlorobenzene	1.0	70
2,4,5-Trichlorophenol	3.0	300
2,3,4,6-Tetrachlorophenol	1.0	70
1,3,5-Trinitrobenzene	2.0	330
o-Toluidine	1.0	70
Safrole	1.0	70

Note: ND = not detected.

*Based on ESE's MDL studies; however, the reporting limits of compounds that are difficult to analyze; were adjusted to a concentration that is detected more reliably. The MDL studies were conducted according to the 40 CFR 136 Appendix B protocols.

Source: ESE.

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Table 5-40. Analytes, Precision, and Accuracy Data for Carbamates and Urea Pesticides, EPA 632 and Modified 632*

Parameter	Aqueous Precision (RPD	Aqueous Accuracy (% Recovery)	Solid Precision (RPD)	Solid Accuracy (% Recovery)
Aldicarb	NA	NA	5	92-102
Aldicarb sulfone	NA	NA	4	64-72
Aldicarb sulfoxide	NA	NA	4	13-22
Carbaryl (sevin)'	55''	34-144''	43''	35-124''
Carbofuran'	37''	53-127''	34''	43-111''
Diuron'	29''	60-118''	19''	58-96''
Linuron'	26''	66-118''	37''	42-116''
Methiocarb	35	87-103	29	71-129
Methomyl	35	67-82	4	66-74
Monuron	35	92-102	23	82-128
Oxamyl	35	62-112	5	55-65
Fluorometron'	35	64-143	35	64-134
Propoxur	22	65-109	22	65-109
Barban'	12	86-110	12	86-110
Chloropham	12	83-107	12	83-107
Neburon	20	76-116	20	76-116
Propham'	18	70-106	18	70-106

Reference:' Accuracy: EPA Method 632--Test Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater, EPA, January 1982.
Precision: ESE, meets or exceeds the RPD criteria that was calculated from the spiking and recovery information presented in the method (EPA 632).

Note: NA = method is not applicable.

* See Appendix A for Modified Method 632.
' Matrix spike and QC check sample compound.
'' Based on the data validation study.
'' Accuracy and precision criteria are based on ESE historical data.

Source: ESE.

94132801.1190

Table 5-41. Reporting Limit Data for Carbamates and Urea Pesticides, EPA 632 and Modified 632

Parameter	Reporting Limits Aqueous* (µg/L)	Solid** (µg/kg)
Aldicarb	NA	250
Aldicarb sulfone	NA	250
Aldicarb sulfoxide	NA	250
Carbaryl (sevin)	1.5	550
Carbofuran	2.5	1,000
Diuron	0.6	260
Linuron	0.65	270
Methiocarb	5.0	2,000
Methomyl	3.0	1,500
Monuron	0.65	260
Oxamyl	1.5	510
Fluorometron	0.5	200
Propoxur	4.0	1,700
Barban	2.0	940
Chlorpropham	1.5	700
Neburon	0.5	47
Propham	2.5	1,100

*Based on the lowest standard that ESE routinely uses, taking into account the sample volume and final extract volume. The lowest standard is chosen to be within the range of 5 to 10 times the background noise of the instrument.

**Based on the lowest standard that ESE routinely uses, taking into account the sample weight and final extract volume. The lowest standard is chosen to be within the range of 5 to 10 times the background noise of the instrument. The solid reporting limits are expressed on a weight basis.

Source: ESE.

94132801.1191

Table 5-42. Analytes, Precision, and Accuracy Data for Chlorinated Hydrocarbons, EPA 612 and SW 3510/3520/3540/3550/8120

	Aqueous		Solid	
	Precision (RPD)	Accuracy (% Recovery)	Precision (RPD)	Accuracy (% Recovery)
2-Chloronaphthalene	30	9-148	50	9-148
1,2-Dichlorobenzene*	30	9-160	50	9-160
1,3-Dichlorobenzene	30	0-150	50	0-150
1,4-Dichlorobenzene	30	13-157	50	13-157
Hexachlorobenzene*	30	15-159	50	15-159
Hexachlorobutadiene*	30	0-139	50	0-139
Hexachlorocyclopentadiene	30	0-111	50	0-111
Hexachloroethane*	30	8-139	50	8-139
1,2,4-Trichlorobenzene*	30	5-149	50	5-149

Reference: Accuracy: EPA Method SW8120--Test Methods for Evaluating Solid Wastes, EPA-SW-846 3rd Edition, September 1986.
Precision: ESE, meets or exceeds the RPD criteria that can be calculated from the spiking and recovery information presnted in the method SW 8120.

*Matrix spike and QC check sample compound.

Source: ESE.

94132801.1192

Table 5-43. Reporting Limit Data for Chlorinated Hydrocarbons, EPA 612 and SW 3510/3520/3540/3550/8120

Parameter	Reporting Limits Aqueous* (µg/L)	Reporting Limits Solid† (µg/kg)
2-Chloronaphthalene	0.200	40.0
1,2-Dichlorobenzene	0.100	20.0
1,3-Dichlorobenzene	0.100	20.0
1,4-Dichlorobenzene	0.100	20.0
Hexachlorobenzene	0.012	2.00
Hexachlorobutadiene	0.012	2.10
Hexachlorocyclopentadiene	0.012	2.40
Hexachlorethane	0.012	2.40
1,2,4-Trichlorobenzene	0.15	2.60

*Based on the lowest standard that ESE routinely uses, taking into account the sample volume and final extract volume. The lowest standard is chosen to be within the range of 5 to 10 times the background noise of the instrument.

†Based on the lowest standard that ESE routinely uses, taking into account the sample weight and final extract volume. The lowest standard is chosen to be within the range of 5 to 10 times the background noise of the instrument. The solid reporting limits are expressed on a wet weight basis.

Source: ESE.

94/3280-1193

Table 5-44. Analytes, Precision, and Accuracy Data for Triazines, EPA 619

Parameter	Aqueous Precision (RPD)	Aqueous Accuracy (% Recovery)
Ametryne*	30	74-134
Atrazine	30	78-138
Prometon*	17	50-84
Prometryne	51	59-161
Propazine	24	92-140
Simatryn	36	147-200
Simazine*	24	75-123
Terbutylazine	45	69-159
Terbutryn	36	47-119

Reference: Accuracy and Precision: EPA Method 619 -- Test Method for Organic Chemical Analysis of Municipal and Industrial Wastewater, EPA 600/4-82-057, July 1982.

*Matrix spike and QC check sample compound.

Source: ESE.

94132801-1194

Table 5-45. Reporting Limit Data for Triazines, EPA 619

Parameter	Reporting Limits Aqueous* (µg/L)
Ametryn	0.3
Atrazine	0.3
Prometon	1.2
Prometryne	0.6**
Propazine	0.3**
Simatryn	0.7**
Simazine	0.6**
Terbuthylazine	0.3**
Terbutryn	0.6**

*Based on the lowest standard that ESE routinely uses, taking into account the sample volume and final extract volume. The lowest standard is chosen to be within the range of 5 to 10 times the background noise of the instrument.
**Ten times the detection limits specified in the Method EPA 619.

Source: ESE.

94113280.1195

Table 5-46. Analytes, Precision, and Accuracy Data for Organonitrogen Pesticides, EPA 633

Parameter	Aqueous Precision (RPD)	Aqueous Accuracy (% Recovery)
Bromacil*	40	82-162
Deet	6	99-111
Hexazinone*	23	78-124
Metrabuzin*	29	83-141
Terbacil	25	61-111
Triadimefon	13	84-110
Tricyclazole	22	56-100

Reference: Accuracy and Precision: EPA Method 633--Test Method for Organic Chemical Analysis of Municipal and Industrial Wastewater, EPA 600/4-82-057, July 1982.

*Matrix spike and QC check sample compound.

Source: ESE.

94 13280.1196

Table 5-47. Reporting Limit Data for Organonitrogen Pesticides, EPA 633

Parameter	Reporting Limits Aqueous* (µg/L)
Bromacil	2.5
Deet	1.0**
Hexazinone	2.5
Metribuzin	1.5
Terbacil	2.0**
Triadimefon	7.0**
Tricyclazole	1.0**

*Based on the lowest standard that ESE routinely uses, taking into account the sample volume and final extract volume. The lowest standard is chosen to be within the range of 5 to 10 times the background noise of the instrument.
**Ten times the detection limits listed in the Method EPA 633.

Source: ESE.

3413280.1197

Table 5-48. Analytes, Precision, and Accuracy Data for Certain Amine Pesticides and Lethane, EPA 645

Parameter	Aqueous	
	Precision (RPD)	Accuracy (% Recovery)
Alachlor*	40	64-144
Butachlor	25	68-118
Diphenamid	43	57-143
Fluridone*	35	57-127
Lethane*	60	33-153
Norflurazon	22	68-112

Reference: Accuracy and Precision: EPA Method 645 -- Test Method for Organic Chemical Analysis of Municipal and Industrial Wastewater, EPA 600/4-82-057, July 1982.

*Matrix spike and QC check sample compound.

Source: ESE.

94132801.1198

Table 5-49. Reporting Limit Data for Certain Amine Pesticides and Lethane, EPA 645

Parameter	Reporting Limits Aqueous* (µg/L)
Alachlor	2.0
Butachlor	3.0
Diphenamid	2.0
Fluridone	5.0
Lethane	1.0
Norflurazon	0.2

*Ten times the detection limits listed in the method, EPA 645.

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Table 5-50. Analytes, Precision, and Accuracy Data for Nitroaromatics and Nitramines by High Performance Liquid Chromatography (HPLC), SW 8330

	Aqueous†		Solid†	
	Precision (RPD)	Accuracy (% Recovery)	Precision (RPD)	Accuracy (% Recovery)
HMX*	13	84-111	18	80-116
RDX*	30	51-111	18	71-107
1,3,5-Trinitrobenzene*	28	46-102	25	65-115
1,3-Dinitrobenzene††	37	58-132	30	70-130
Methyl-2,4,6-Trinitro-phenylnitramine (Tetryl)††	21	67-109	46	65-157
Nitrobenzene*	32	44-108	24	72-120
2,4,6-Trinitrotoluene*	38	48-124	23	72-118
2,4-Dinitrotoluene*	21	60-102	19	68-106
2,6-Dinitrotoluene††	26	67-119	44	58-146
o-Nitrotoluene††	28	53-109	22	70-114
m-Nitrotoluene††	48	40-136	48	40-136
p-Nitrotoluene††	26	60-112	26	60-112

*Matrix spike and QC check sample compound
†Accuracy and precision criteria based on ESE historical data, unless specified differently.
††Accuracy and precision criteria based on ESE method validation studies.

Source: ESE.

Table 5-51. Reporting Limit Data for Nitroaromatics and Nitroamines by High Performance Liquid Chromatography, SW 8330

Parameter	Reporting Limit Aqueous* (μg/L)	Reporting Limit Solid† (μg/kg)
HMX	0.25	500
RDX	0.25	500
1,3,5-Trinitrobenzene	0.20	250
1,3-Dinitrobenzene	0.10	200
Methyl-2,4,6-Trinitro-phenylnitramine	0.20	300
Nitrobenzene	0.20	300
4-Amino-2,6-Dinitrotoluene	0.15	250
2,4,6-Trinitrotoluene	0.15	250
2-Amino-4,6-Dinitrotoluene	0.15	250
2,4-Dinitrotoluene	0.15	150
2,6-Dinitrotoluene	0.15	200
o-Nitrotoluene	0.25	500
m-Nitrotoluene	0.25	500
p-Nitrotoluene	0.30	600

*Based on the lowest standard that ESE routinely uses, taking into account the sample volume and final extract volume. The lowest standard is chosen to be within the range of 50 to 10 times the background noise of the instrument.

†Based on the lowest standard that ESE routinely uses, taking into account the sample weight and final extract volume. The lowest standard is chosen to be within the range of 5 to 10 times the background noise of the instrument. The solid reporting limits are expressed on a wet weight basis.

Source: ESE.

Table 5-52. Analytes, Precision, and Accuracy Data for Nitroaromatics and Nitramines by High Performance Liquid Chromatography (HPLC), AEC QA Plan 11/92**

	Aqueous†		Solid†	
	Precision (RPD)	Accuracy (% Recovery)	Precision (RPD)	Accuracy (% Recovery)
HMX††	13	84-111	18	80-116
RDX*	30	51-111	18	71-107
1,3,5-Trinitrobenzene*	28	46-102	25	65-115
1,3-Dinitrobenzene††	37	58-132	30	70-130
Methyl-2,4,6-Trinitro-phenylnitramine (Tetryl)††	21	67-109	46	65-157
Nitrobenzene*	32	44-108	24	72-120
2,4,6-Trinitrotoluene*	38	48-124	23	72-118
2,4-Dinitrotoluene*	21	60-102	19	68-106
2,6-Dinitrotoluene	26	67-119	44	58-146
o-Nitrotoluene*	28	53-109	22	70-114
m-Nitrotoluene††	48	40-136	48	40-136
p-Nitrotoluene††	26	60-112	26	60-112

*Matrix spike and QC check sample compound
†Accuracy and precision criteria based on ESE historical data, unless specified differently.
**UW32 and LW12 are ESE's USATHAMA approved methods (see Appendices H and I).
††Accuracy and precision criteria based on ESE method validation studies for Methods LW12 and UW32.

Source: ESE.

Table 5-53. Reporting Limit Data for Nitroaromatics and Nitroamines by High Performance Liquid Chromatography, AEC QA Plan 11/92

Parameter	Reporting Limit Aqueous* (μg/L)	Reporting Limit Solid† (μg/kg)
HMX	0.25	500
RDX	0.25	500
1,3,5-Trinitrobenzene	0.20	250
1,3-Dinitrobenzene	0.10	200
Methyl-2,4,6-Trinitro-phenylnitramine	0.20	300
Nitrobenzene	0.20	300
4-Amino-2,6-Dinitrotoluene	0.15	250
2,4,6-Trinitrotoluene	0.15	250
2-Amino-4,6-Dinitrotoluene	0.15	250
2,4-Dinitrotoluene	0.060	150
2,6-Dinitrotoluene	0.070	200
o-Nitrotoluene	0.25	500
m-Nitrotoluene	0.25	500
p-Nitrotoluene	0.30	600

*Based on the lowest standard that ESE routinely uses, taking into account the sample volume and final extract volume. The lowest standard is chosen to be within the range of 50 to 10 times the background noise of the instrument.

†Based on the lowest standard that ESE routinely uses, taking into account the sample weight and final extract volume. The lowest standard is chosen to be within the range of 5 to 10 times the background noise of the instrument. The solid reporting limits are expressed on a wet weight basis.

Source: ESE.

94132E0.1203

Table 5-54. Analyte, Precision, and Accuracy Data for Glyphosate, EPA 547 (Modified)

Parameter	Aqueous* Precision (RPD)	Aqueous* Accuracy (% Recovery)
Glyphosate	18	90-126

*Precision and accuracy are based on method validation study performed by ESE (see Appendix V).

Source: ESE.

94 3280 1204

Table 5-55. Reporting Limit Data for Glyphosate. EPA 547 (Modified)

Parameter	Reporting Limit Aqueous* (µg/L)
Glyphosate	2.5

*Based on the lowest standard that ESE routinely uses, taking into account the sample volume and final extract volume. The lowest standard is chosen to be within the range of 5 to 10 times the background noise of the instrument.

Source: ESE.

9413230.1205

Table 5-56. Analyte, Precision, and Accuracy Data for Ethylene-Bis-Dithiocarbamates (EBDC), EPA 630.1 (Modified)

	Aqueous*		Solid*	
	Precision (RPD)	Accuracy (% Recovery)	Precision (RPD)	Accuracy (% Recovery)
EBDC	9	92-100	12	67-91

*Precision and accuracy are based on method validation studies performed by ESE (see Appendix W).

Source: ESE.

9443280.1206

Table 5-57. Reporting Limit Data for Ethylene-Bis-Dithiocarbamates (EBDC), EPA 630.1 (Modified)

Parameter	Reporting Limit Aqueous* (µg/L)	Reporting Limit Solid† (µg/kg)
EBDC	5.5	100

*Based on the lowest standard that ESE routinely uses, taking into account the sample volume and final extract volume. The lowest standard is chosen to be within the range of 5 to 10 times the background noise of the instrument.

Source: ESE.

94152803-1207

Table 5-58. Analytes, Precision, and Accuracy Data for Organochlorine Pesticides and PCBs in Water, EPA 617

Parameter	Aqueous Precision (RPD)	Aqueous Accuracy (% Recovery)
Aldrin[a]	45[b]	37 - 127[b]
BHC, A	30	37 - 134
BHC, B	30	17 - 147
BHC, D	27	68 - 122
BHC, G (lindane)[a]	51[b]	43 - 145[b]
Chlordane	30	45 - 119
DDD, PP[a]	15	79 - 109
DDE, PP[a]	11	79 - 101
DDT, PP[a]	14	77 - 105
Dieldrin	15	83 - 113
Endosulfan, A	23	80 - 124
Endosulfan, B	14	79 - 107
Endosulfan sulfate	30	26 - 144
Endrin[a]	60[b]	35 - 155[b]
Endrin aldehyde	40[b]	58 - 138[b]
Heptachlor[a]	38[b]	48 - 124[b]
Heptachlor epoxide	12	82 - 106
Methoxychlor	20	77 - 117
Toxaphene	30	41 - 126
Mirex	14	75 - 103
Trifluralin	32	62 - 126
PCNB	19	64 - 102
PCB-1061[d]	30	50 - 114
PCB-1221	30	15 - 178
PCB-1232	30	10 - 215
PCB-1242	30	39 - 150
PCB-1248	30	38 - 158
PCB-1254	30	29 - 131
PCB-1260[d]	30	8 - 127
Dibutylchlorendate[c]	NA	46 - 146[b]

94132BD 1208

Table 5-58. Analytes, Precision, and Accuracy Data for Organochlorine Pesticides and PCBs in Water, EPA 617 (Continued, Page 2 of 2)

Reference: Accuracy and Precision: EPA Methods 617 and SW 8080.

Note: NA = not applicable.

[a]Matrix spike and QC check sample compound.
[b]Accuracy and precision criteria are based on ESE historical data.
[c]Surrogate; the surrogate is added to all environmental samples and quality control samples.
[d]PCB 1016 and PCB 1260 are only used as matrix spike and QCC samples compounds when using EPA 608/8080 to evaluate PCBs only.

Source: ESE.

94132BD-1209

Table 5-59. Reporting Limit Data for Organochlorine Pesticides and PCBs in Water, EPA 617

Parameter	Reporting Limits Aqueous* (μg/L)
Aldrin	0.006
BHC.A	0.006
BHC.B	0.006
BHC,D	0.006
BHC,G(lindane)	0.006
Chlordane	0.030
DDD,PP	0.006
DDE,PP'	0.006
DDT,PP'	0.006
Dieldrin	0.006
Endosulfan,A	0.006
Endosulfan,B	0.006
Endosulfan sulfate	0.006
Endrin	0.006
Endrin aldehyde	0.006
Heptachlor	0.006
Heptachlor epoxide	0.006
Methoxychlor	0.006
Toxaphene	0.6
PCB-1016	0.12
Mirex	0.2
Trifluralin	0.1
PCNB	0.02

.94132BD.1210

Table 5-59. Reporting Limit Data for Organochlorine Pesticides and PCBs in Water, EPA 617 (Continued, Page 2 of 2)

Parameter	Reporting Limits Aqueous* (μg/L)
PCB-1221	0.12
PCB-1232	0.12
PCB-1242	0.12
PCB-1248	0.12
PCB-1254	0.12
PCB-1260	0.12

*Based on the lowest standard that ESE routinely uses, taking into account the sample volume and final extract volume. The lowest standard is chosen to be within the range of 5 to 10 times the background noise of the instrument.

Source: ESE.

94132B0.121

Table 5-60. Analyte, Precision, and Accuracy Data for Tetrazene, EPA 8331

Parameter	Aqueous* Precision (RPD)	Aqueous* Accuracy (% Recovery)	Solid* Precision (RPD)	Solid* Accuracy (% Recovery)
Tetrazene	10	94-114	25	35-85

*Precision and accuracy are based on EPA Method 8331--Test Methods for Evaluating Solid Waste, EPA SW-846, 3rd Edition, September 1986.

Source: ESE.

94132801.1212

Table 5-61. Reporting Limit Data for Tetrazene, EPA 8331

Parameter	Reporting Limit	
	Aqueous* (μg/L)	Solid (μg/kg)
Tetrazene	7	1,000

Source: ESE.

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94132B0.1214

6.0 SAMPLE HANDLING PROCEDURES

6.1 INTRODUCTION

The validity of analytical data is dependent on the integrity of the field procedures employed in obtaining a sample. Environmental sampling has many variables which can affect analytical results. The properties of most contaminated materials warrant the analysis of a small aliquot of the bulk of the material. Proper sampling techniques must be employed to obtain a representative sample of the bulk material. For a sample to be representative, it must be collected and handled so as to keep its original physical form and chemical composition as much as possible and to protect against any loss or contamination. To achieve this sample's integrity, quality assurance procedures should be closely followed throughout the sampling effort.

Exhaustive and sometimes expensive actions are taken based on the analytical data generated from field sampling programs. Therefore, it is in the best interest of the investigation, as well as the public, to ensure the quality of the data by ensuring the quality of the samples being delivered to the analyst.

This section of the LCQAP details sample handling requirements in the laboratory.

6.2 SAMPLE CONTAINERS CLEANING PROCEDURES

6.2.1 CLEANING PROCEDURES

ESE uses commercially cleaned sample containers whenever practical. At a minimum, only Type 200 series precleaned sample containers will be used. For HAZWRAP and other projects, as required, only sample containers provided with certificate of cleanliness will be used and the certificates will be kept on file. Table 6-1 summarizes the application of these cleaning procedures. If containers are cleaned and prepared inhouse, the same procedures will be followed. Cleaned sample containers are stored in a secured

Table 6-1. Sample Container Cleaning Procedures Within the Laboratory

Analysis/Parameter	Container Type	Matrix	Fraction Code	Cleaning Protocol*
Organic extractables include GC, HPLC, GC/MS, and Total Phenols Analyses	Glass jar with Teflon®-lined cap	Water	MS, EC, HB, UP, NP, LC, W, Z	A
	Glass jar with Teflon®-lined cap	Soil/Sediment	SS	A
	Aluminum foil and plastic bags	Tissue	TS	NA
Organic purgeables including GC and GC/MS Analyses, TOX, Aldicarb	Glass septum vial with Teflon®-lined cap	Water	V, VP, ED, AL, XP	B
	Wide-mouth glass jar with Teflon®-lined cap	Soil	SV	B
	Aluminum foil and plastic bags	Tissue	TS	NA
Metals	Linear polyethylene cubitainer with polyethylene cap	Water	N	C
	Glass jar with Teflon®-lined cap (or new plastic)	Soil/Sediment	SS	A
	Plastic bags	Tissue	TS	NA
Inorganics include total cyanide, alkalinity, acidity, residues, BOD, color, MBAS, COD, TOC, chloride, turbidity, sulfate, bromide, sulfide, fluoride, nutrients, and radionuclides	Linear polyethylene cubitainer with polyethylene cap	Water	C, B, S, H, R	D*
	Glass jar with Teflon®-lined cap (or new plastic)	Soil	SS	A
	Aluminum foil and plastic bags	Tissue	TS	NA
Oil and grease (O&G), odor	Glass jar with Teflon®-lined cap	Water	O,OD	A
Oil and grease (O&G)	Glass jar with Teflon®-lined cap	Soil/Sediment	SS	A

Table 6-1. Sample Container Cleaning Procedures Within the Laboratory (Continued. Page 2 of 2)

Note:
BOD = biochemical oxygen demand.
COD = chemical oxygen demand.
GC/MS = gas chromatography/mass spectrometry.
GC/HPLC = gas chromatography/high performance liquid chromatography.
Glass = amber for all organic water analyses.
MBAS = methylene blue active substance.
NA = not applicable.
TOC = total organic carbons.
TOX = total organic halids.

*Tissue samples for these parameters are first wrapped in aluminum foil and then put in plastic bags.

*Cleaning Protocol A	B	C	D	Specifications
X	X	X		Wash with hot tap water using laboratory-grade, interference free, nonphosphate detergent.
X	X	X		Rinse 3 times with tap water.
X		X		Rinse with 1:1 nitric acid (reagent-grade nitric acid diluted with ASTM Type 1 deionized water).
X	X	X		Rinse 3 times with ASTM Type 1 deionized water.
X				Rinse with pesticide-grade methylene chloride using 20 mL per 64-oz bottle, 10 mL per 32- or 16-oz bottle, or 5 mL per 8- or 4-oz bottle. Methylene chloride is used as organics rinse.
X	X			Oven dry, using a forced-air oven, at 105 to 125 C for 1 hour.
		X		Invert and air-dry in contaminant-free environment.
X	X	X		The containers are sealed with caps containing Teflon® liners or Teflon®-backed septa that had been cleaned the same way as the containers, packed in cartons, and stored until needed.
			X	No cleaning required; use new cubitainers (only).

Note: Cleaning protocols A, B, and C are applied by commercial supplier.
Cleaning protocol D is applied by ESE.
Source: ESE.

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storage building away from the analytical laboratory until needed. Occasional audits of containers to document freedom from contaminants will be performed to supplement the various blanks that are frequently and routinely analyzed to provide similar QC data. Activities and records associated with contaminant-free containers are maintained.

All sample containers, either commercially cleaned or prepared inhouse, are stored in a secured storage building located away from the laboratory. When containers are needed, they are moved to the sample kit preparation area that is also located away from the laboratory and packed for shipment to the project site. Upon receipt of precleaned sample containers, the purchase order form is dated with date of receipt by the laboratory purchasing personnel and the purchase order form is filed. Documentation associated with the sample containers such as lot numbers and certification statements for 300 series containers are maintained and filed in their department by the kit preparation personnel. These containers are labeled individually with lot numbers, hence, it is not necessary to maintain records of lot numbers used for a particular project.

6.2.2 TYPES OF WATER

DI water is defined as ESE water that has been treated by passing it through a standard resin column and an activated carbon unit. The water contains no detectable (i.e., ESE's routine detection limits) heavy metals or inorganic compounds of analytical interest and is relatively free of organic compounds. The water is acceptable for use in the initial rinsing of laboratory glassware and field equipment. Ultrapure water, used for equipment and field blanks, is defined as ESE DI water that has been additionally treated through a Milli-Q® treatment system and contains no organic compounds of analytical interest above ESE's routine detection limits. Organic-free water, used for trip blanks, is prepared by purging American Society for Testing and Materials (ASTM) Type 2 water at 60°C for 24 hours with Grade 6 helium.

Documentation is maintained to demonstrate reliability and "purity" of analyte free water source(s).

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DI water other than ESE-treated water may be used if it is of documented equivalent quality. Use of commercially DI or distilled water is discouraged because it often contains phthalate esters.

6.3 SAMPLING CONTAINERS, VOLUMES, HOLDING TIMES AND PRESERVATION

6.3.1 CONTAINERS AND SAMPLE HOLDING TIMES

Table 6-2 identifies the proper containers, preservation techniques, and maximum holding times established by EPA (40 CFR Part 136). The maximum holding times in Table 6-1 apply to water and soils as noted. Samples that exceed the regulatory holding times will be flagged by the laboratory coordinator in the final deliverable.

6.3.2 SAMPLE PRESERVATION

Sample preservation is generally performed in the field. However, sample containers for volatile analysis (water only) are sent to the field with preservatives added to the containers. Sample preservation requirements are listed in Table 6-2.

Grades of the preservatives used are specified as a footnote in Table 6-2. Fresh preservatives are obtained from laboratory stocks prior to each sampling event.

6.4 SAMPLE SHIPPING FROM THE FIELD TO THE LABORATORY

A typical environmental sample consists of some type of soil or water matrix; however, other types of samples such as tissues or dust wipes are also collected. Whatever the field sample type, the field crew should package each sample container to ensure its integrity inside the shipping container. This packaging may include packing materials such as Bubble Wrap® or styrofoam fillers.

9413280.1218

Table 6-2. Required Containers, Preservation Techniques, and Holding Times

Measurement	Container[1]	Preservation	Maximum Holding Time[2] (Waters and Soils)
Metals			
Chromium VI	P, G	Cool, 4°C	24 hours[3]
Mercury	P, G	HNO_3 to pH < 2	28 days
Metals, except chromium VI and mercury[4] (filtered and unfiltered)	P, G	HNO_3 to pH < 2	6 months
Inorganic Tests			
Acidity	P, G	Cool, 4°C	14 days[3]
Alkalinity	P, G	Cool, 4°C	14 days[3]
Ammonia	P, G	Cool, 4°C, H_2SO_4 to pH < 2	28 days[3]
BOD	P, G	Cool, 4°C	48 hours[3]
Bromide	P, G	None required	28 days[3]
BOD, carbonaceous	P, G	Cool, 4°	48 hours[3]
COD	P, G	Cool, 4°C, H_2SO_4 to pH < 2	28 days[3]
Chloride	P, G	None required	28 days[3]
Chlorine, total	P, G	None required	Analyze immediately[3,5]
Color	P, G	Cool, 4°C	48 hours[3]
Cyanide, total and amenable to chlorination	P, G	Cool, 4°C, NaOH to pH > 12, 0.6 g ascorbic acid[6]	14 days[3,6]
Fluoride	P	None required	28 days[3]
Hardness	P, G	HNO_3 to pH < 2, H_2SO_4 to pH < 2	6 months[3]
Hydrogen ion (pH)	P, G	Cool, 4°C	Analyze immediately[3]
Kjeldahl and organic nitrogen	P,G	Cool, 4°C, H_2SO_4 to pH < 2	28 days[3]
Nitrate	P, G	Cool, 4°C	48 hours[3]
Nitrate (drinking water)			
Chlorinated	P, G	Cool, 4°C	28 days
Unchlorinated[7]	P, G	H_2SO_4 to pH < 2	14 days
Nitrate-nitrite	P, G	Cool, 4°C, H_2SO_4 to pH < 2	28 days[3]
Nitrite	P, G	Cool, 4°C	48 hours[3]
Oil and grease	G	Cool, 4°C, H_2SO_4 to pH < 2	28 days[3]
Organic carbon	P, G	Cool, 4°C, HCl or H_2SO_4 to pH < 2	28 days[3]

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Table 6-2. Required Containers, Preservation Techniques, and Holding Times (Continued, Page 2 of 6)

Measurement	Container[1]	Preservation	Maximum Holding Time[2] (Waters and Soils)
Inorganics (cont)			
Orthophosphate	P, G	Filter immediately, cool, 4°C	48 hours[3]
Oxygen, dissolved (DO)			
Probe	G Bottle and top	None required	Analyze immediately[3]
Winkler	G Bottle and top	Fix onsite and store in dark	8 hours[3] Phenols
	G only	Cool, 4°C, H_2SO_4 to pH < 2	28 days[3]
Phosphorus (elemental)	G	Cool, 4°C	48 hours[3]
Phosphorus, total	P, G	Cool, 4°C, H_2SO_4 to pH < 2	28 days[3]
MBAS	P, G	Cool, 4°C	48 hours[3]
Bromates (ion chromatography)	P, G	Cool, 4°C	30 days[3]
Corrosivity (calculated)	P, G	Cool, 4°C	7 days[3]
Odor	G	Cool, 4°C	6 hours[3]
Unionized Ammonia (calculated)	P, G	Cool, 4°C	8 hours[3]
		$Na_2S_2O_3$	28 days[10]
Residue, total	P, G	Cool, 4°C	7 days[3]
Residue, filterable	P, G	Cool, 4°C	7 days[3]
Residue, nonfilterable (TSS)	P, G	Cool, 4°C	7 days[3]
Residue, settleable	P, G	Cool, 4°C	48 hours[3]
Residue, volatile	P, G	Cool, 4°C	7 days[3]
Silica	P	Cool, 4°C	28 days[3]
Specific conductance	P, G	Cool, 4°C	28 days[3]
Sulfate	P, G	Cool, 4°C	28 days[3]
Sulfide	P, G	Cool, 4°C, add zinc acetate plus NaOH to pH > 9	7 days[3]
Sulfite	P, G	None required	Analyze immediately[3]
Surfactants	P, G	Cool, 4°C	48 hours[3]
Temperature	P, G	None required	Analyze immediately[3]
Turbidity	P, G	Cool, 4°C	48 hours[3]
Organic Tests			
Purgeable halocarbons	G, Teflon[7]-lined septum	Cool, 4°C, 0.008% $Na_2S_2O_3$[9], store in dark	14 days

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Table 6-2. Required Containers, Preservation Techniques, and Holding Times (Continued, Page 3 of 6)

Measurement	Container[1]	Preservation	Maximum Holding Time[2] (Waters and Soils)
Organics (cont)			
Purgeable aromatic hydrocarbons	G. Teflon[3]-lined septum	Cool, 4°C, 0.008% $Na_2S_2O_3$[5], HCl to pH2	14 days
Acrolein and acrylonitrile	G. Teflon[3]-lined septum	Cool, 4°C, 0.008% $Na_2S_2O_3$, Adjust pH to 4-5	14 days
Phenols	G. Teflon[3]-lined cap	Cool, 4°C, 0.008% $Na_2S_2O_3$[5], store in dark	7/40 days for waters[4] 14/40 days for soils[4]
Benzidines	G. Teflon[3]-lined cap	Cool, 4°C, 0.008% $Na_2S_2O_3$[5], store in dark	7/40 days for waters[4]
Phthalate esters	G. Teflon[3]-lined cap	Cool, 4°C, store in dark	7/40 days for waters[4] 14/40 days for soils[4]
Nitrosamines	G. Teflon[3]-lined cap	Cool, 4°C, 0.008% $Na_2S_2O_3$[5], store in dark	7/40 days for waters[4] 14/40 days for soils[4]
PCBs, pesticides, herbicides	G. Teflon[3]-lined cap	Cool, 4°C, 0.008% NA_2S_2O3[5], store in dark	7/40 days for water[4] 14/40 days for soils[4]
Nitroaromatics and isophorone	G. Teflon[3]-lined cap	Cool, 4°C, 0.008% $Na_2S_2O_3$[5], store in dark	7/40 days for water[4] 14/40 days for soils[4]
Polynuclear aromatic hydrocarbons	G. Teflon[3]-lined cap	Cool, 4°C, 0.008% $Na_2S_2O_3$[5], store in dark	7/40 days for waters[4] 14/40 days for soils[4]
Haloethers	G. Teflon[3]-lined cap	Cool, 4°C, 0.008% $Na_2S_2O_3$[5], store in dark	7/40 days for waters[4] 14/40 days for soils[4]
Volatile organics	G. Teflon[3]-lined septum	Cool, 4°C, 0.008% Na_2SO_3[5], HCL to pH 2	14 days
EDB, DBCP	G. Teflon[3]-lined septum	Cool, 4°C, 0.008% $Na_2S_2O_3$[5]	28 days
Chlorinated hydrocarbons	G. Teflon[3]-lined cap	Cool, 4°C, store in dark	7/40 days for waters[4] 14/40 days for soils[4]
TCDD	G. Teflon[3]-lined cap	Cool, 4°C, 0.008% $Na_2S_2O_3$[5], store in dark	7/40 days for waters[4] 14/40 days for soils[4]
Total organic halogens (TOX)	G. Teflon[3]-lined cap	Cool, 4°C, H_2SO_4 to pH < 2 store in dark	28 days[5]

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Table 6-2. Required Containers, Preservation Techniques, and Holding Times (Continued, Page 4 of 6)

Measurement	Container[1]	Preservation	Maximum Holding Time[2] (Waters and Soils)
Organics (cont)			
Acid and base/neutral extractables	G, Teflon™-lined cap	Cool, 4°C, 0.008% $Na_2S_2O_3$[3] store in dark	7/40 days for waters[4] 14/40 days for soils[4]
Nitroaromatics and Nitramines	G, Teflon™-lined cap	Cool, 4°C	7/40 days for waters[4] 14/40 days for soils[4]
Radiological Tests			
Alpha, beta, Sr-90, Ra-226, Ra-228, Uranium, photon emitters	P, G	HCL, HNO_3 to pH < 2	6 months
Cesium-134, Iodine-131, Titrium	P, G	None	6 months
Tissues			
Organics, inorganics and radiological tests	Aluminum foil and plastic bag	Freeze, -20°C or below	12 months
Metals tests	Plastic bag	Freeze, -20°C or below	12 months

Note:
BOD = biochemical oxygen demand.
COD = chemical oxygen demand.
G = glass.
HCl = hydrochloric acid (metals grade).
HNO_3 = nitric acid (metals grade).
H_2SO_4 = sulfuric acid (metals grade).
NS = none specified by EPA.
Na_2SO_3 = sodium sulfite (ACS grade).
$Na_2S_2O_3$ = sodium thiosulfate (ACS grade).
P = polyethylene.
PCB = polychlorinated biphenyl.
NaOH = sodium hydroxide (ACS grade).
°C = degrees Celsius.

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Table 6-2. Required Containers, Preservation Techniques, and Holding Times (Continued, Page 5 of 6)

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1 For nonvolatile organics, containers for soil and sediment samples are glass with Teflon®-lined caps and for volatiles, containers are glass with Teflon®-lined septum.
Soil sample containers for inorganics are glass jars with Teflon®-lined caps, polyethylene (P), or glass (G).

2 Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still considered valid. Samples may be held for longer periods only if the laboratory has data on file to show that the specific types of samples under study are stable for the longer time.

3 Holding times provided are for waters. EPA does not have holding times for these parameters in soil. These water holding times will be used as goals for those methods where a soil analysis is applicable.

4 7/40 = 7 days until extraction; 40 days from extraction until analysis. 14/40 = 14 days until extraction; 40 days from extraction until analysis.

5 Sample preservation should be performed immediately upon sample collection. The only preservation for soil samples is cooling at 4°C. For composite samples, each aliquot should be preserved at the time of collection. When use of an automatic sampler makes it impossible to preserve each aliquot, samples may be preserved by maintaining at 4°C until compositing and sample splitting are completed (maximum allowable time is 20 hours). $Na_2S_2O_3$ is used only in the presence of residual chlorine.

6 If residual chlorine is present, sodium thiosulfate is added to the sample vial first, the vial is then filled to almost full volume with sample, acid is added, and finally the vial is filled. Note: It is not recommended to mix the two preservatives (and sample) together in an intermediate vessel.

7 These parameters are best analyzed in the field. In consideration of shipping limitations, when these analyses are requested of our laboratory for confirmation purposes, ESE's policy is to analyze these constituents within 24 hours of receipt.

8 The following test should be performed for cyanide samples:
(a) Oxidizing agents--Test the sample using KI-starch paper. If present, add a few crystals of ascorbic acid and test until negative. Add an additional 0.6 gram of ascorbic acid for each liter of sample to remove the chlorine.
(b) Sulfides--When sulfide is present as indicated by a positive test with lead acetate paper, the maximum holding time is 24 hours. Remove the sulfides by (1) filtration of sample if visible particulates are present, (2) precipitation with cadmium nitrate until a negative spot test is obtain, (3) filtration of the precipitate, and (4) addition of NaOH to pH > 12 if sulfides are not removed with the previous procedure.

9 Temperature and pH must be measured onsite at the time of sample collection. Seven days is the maximum time for laboratory analysis of total alkalinity, calcium ion, and total solids.

10 The results of the measurements of pH, temperature, salinity (if applicable), and the ammonium ion concentration in the sample are used to calculate the concentration of ammonia in the un-ionized state. Temperature, pH, and salinity must be measured onsite at the time of sample collection. Laboratory analysis of the ammonium ion concentration should be conducted within 8 hours of sample collection. If prompt analysis of ammonia is impossible, preserve samples with H_2SO_4 to pH between 1.5 and 2. Acid-preserved samples, stored at 4°C, may be held up to 28 days for ammonia determination. Sodium thiosulfate should only be used if fresh samples contain residual chlorine.

11 Chlorinated means that the source water has a detectable amount of residual chlorine, as will be indicated by the field test.

12 Nonchlorinated means that the source water contains no detectable amount of residual chlorine (i.e., below the detection limit).

Source: ESE.

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Sample containers are typically shipped by bonded courier to the laboratory. Samples are shipped by overnight delivery as soon as possible after collection (usually daily), with receiving signature required. Sample receipt and check-in at the laboratory is performed by the sample custodian, as described in Section 7.3.

Samples are usually organized by sample location in each shipping container with all of the fractions collected from a given station grouped together. A possible exception to this procedure would include the collection of large quantities of samples for VOC analyses.

If the samples require chilling/freezing, the sample containers will be isolated from the chilling/freezing materials using appropriate, waterproof materials such as plastic garbage bags. Typically, wet ice is used to chill the samples; reusable blue ice-type chilling products will not be used due to possible chemical interferences. If a sample must be kept frozen in a solid state, dry ice is used.

The chain-of-custody logsheet for the samples in each shipping container is sealed in a plastic Ziploc® bag and taped to the inside of the container. ESE's policy requires sealing all sample shipping containers with evidence tape prior to shipping.

6.5 REAGENT AND STANDARD STORAGE

Storage requirements of reagents and standards used are presented in Table 6-3.

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Table 6-3. Reagent Storage

Reagent	Method of Storage
Solvents	Stored in original containers in a vented storage room, or stored in double-walled flammable liquid storage cabinets. Stockroom personnel check the storage cabinets daily and tranfer solvents from the storage room to the storage cabinets as needed. Note: Methanol used for volatile organic analyses are stored in the GC-Volatiles and GC/MS-Volatiles analysis areas.
Inorganic acids	Stored in original containers in the ESE stockroom. Once issued from the stockroom to a department, the acids are kept in safety carriers and stored along with the carriers in the department's cabinet designated for acids only.
Organic acids	Stored in original containers in the ESE stockroom. Once issued from the stockroom to a deparment, the acids are kept in safety carriers and stored along with the carriers in the department's cabinet designated for acids only. Note: Organic acids are stored in separate cabinets from the inorganic acids.
Caustics	Stored in original containers in the ESE stockroom. Once issued from the stockroom to a department, the caustic reagents are kept in safety carriers and stored along with carriers in the department's cabinet designated for caustics only. Note: Caustic reagents are stored in separate cabinets from the acids.
Other reagents	Stored in the main chemical or standards storage room, or stored in the designated cabinets in each department. Liquids in quantities of one gallon or more must be kept in safety carriers. Standards that require storage at 4°C or at 0°C are stored in each department's refrigerators or freezers (respectively) designated for standards only.

Source: ESE.

7.0 SAMPLE CUSTODY

7.1 SAMPLE CUSTODY OBJECTIVES

The primary objective of sample custody is to create an accurate written verified record that can be used to trace the possession and handling of the samples from the moment of collection until receipt by the laboratory. Adequate sample custody in the laboratory will be achieved by means of approved laboratory documentation.

7.1.1 DEFINITION OF LEGAL CHAIN OF CUSTODY

A sample for this project is defined to be in someone's custody if:

1. It is in one's actual physical possession;
2. It is in one's view, after being in one's physical possession;
3. It is in one's physical possession and then locked or otherwise sealed so that tampering will be evident; or
4. It is kept in a secure area, restricted to authorized personnel only.

7.1.2 LEGAL CUSTODY PROCEDURES

1. Formal chain of custody starts when the precleaned sample containers are dispatched to the field. The sample kit preparation personnel initiate custody of the sample containers by completing the first line under the "Relinquish By" of the chain-of-custody logsheet (Figure 7-5). Receipt of the sample containers are acknowledged by the field personnel by signing and dating the first line under the "Received By" of the logsheet.
2. The formal chain of custody is signed by the Laboratory Coordinator in the laboratory. At the field, the Field Team Leader or his designate, is responsible to ensure that the chain-of-custody form is maintained.
3. Copies of the chain-of-custody form and/or field sheets are maintained with project records.
4. Errors in all documents are corrected by drawing one line though the error, then signing, and dating the corrections.
5. All documentation/logs are signed/initialed by appropriate personnel.

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Due to evidentiary nature of the samples collected, possession must be traceable from the time the precleaned containers leave the laboratory to the field. Field chain of custody actually begins at the laboratory. Sample kits, which refer to the coolers, sample containers, preservatives, and trip blanks, are requested from the kit preparation staff using the Sample Kit Request Form (Figure 7-1). This form is completed by the Laboratory Coordinator and accompanied by the field group logsheets, labels, and any other relevant information. Shipping labels and/or the ESE Shipping Request Form (87201.A) (Figure 7-2) are provided in accordance with current corporate policy on sample kit handling.

The preservatives are packed in fiberboard boxes filled with vermiculites (inert materials compatible with both acids and alkalis) and labeled showing type of preservatives used.

The sample containers, boxed preservatives, trip blanks, if needed, chain-of-custody field logsheet, and a copy of the sample fraction codes are packed in coolers, sealed and shipped to the field by bonded carrier (i.e., UPS or Federal Express). All kit request forms are signed and dated upon completion by kit preparation staff. The number of coolers shipped to the field is documented in the shipping receipts that are kept in a central file located in the Gainesville, Florida, ESE Accounting office. Coolers that are picked up by the field personnel are logged out from the sample kit preparation staff using the Kit Pick-up Log in Figure 7-3. An ESE cooler tracking report indicating the personnel who prepared the kits, cooler number(s), project name and number, contents of each cooler, and the time and date the cooler was released is generated. This report is attached to the kit request form, a copy is packed in the cooler along with the other documentation, and the original filed by the kit preparation staff for future reference. An example of the cooler tracking report is shown in Figure 7-4.

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SAMPLE KIT PREP & SHIPPING REQUEST FORM

FROM _____ EXT # _____

PROJECT NAME _____

FIELD GROUP(s) / SAMPLE #(s) _____

Submitted to Kit Prep on ___/___/___ for shipment between ___/___/___ and ___/___/___

Kits completed by _____ on ___/___/___

Transferred to __ Mailroom __ Facilities by: _____ on ___/___/___

TRIP BLANKS? N / Y. # OF VP _____ V _____ ED _____ Other _____

PRESERVATIVES/FIELD SUPPLIES & EQUIPMENT TO BE SHIPPED ___ In Ice-Chests ___ In Separate Carton

TYPE AND # OF REQUIRED PRESERVATIVE BOTTLES (25mL PER BOTTLE)

For CN (B fraction) ___Cadmium Nitrate (to ppt S if present) ___Lead Acetate strips (to detect S)

___Hydrochloric ___Nitric (for N,R) ___Sodium Hydroxide (for B,H) ___Sodium Sulfite (for TOX/Chlr'd samples

___Sodium Thiosulfate (for THMs + Chlr'd samples) ___Sulfuric (for S,O,Z) ___Zinc Acetate (for H)

OTHER SUPPLIES ___Gloves ___Y Logsheets ___Pipettes ___Y Trash Bags (for ice)

___pH Strips ___Evidence Tape ___Other. _____

FOR PICKUP BY _____ or ___ SHIP AS FOLLOWS:

TO _____
Name

_____
Company

_____
Street Address (or UPS, Fed Ex (NO P.O.Boxes)

_____
City State Zip

( ) _____
Telephone

_____
Project # for Shipping

WEIGHT/VALUE PER PACKAGE

1. ___/___	10 ___/___
2 ___/___	11 ___/___
3 ___/___	12 ___/___
4 ___/___	13 ___/___
5. ___/___	14 ___/___
6 ___/___	15 ___/___
7. ___/___	16. ___/___
8 ___/___	17. ___/___
9. ___/___	18 ___/___

SERVICE REQUIRED

Saturday Service Required? ___Y

__ Airborne	__ DHL	__ Fla Overnite	
__ Fed Express	__ Next AM	__ Next PM	__ 2-Day/Std
__ Trucking	__ AAA/Cooper	__ Carolina (out of state only)	
__ UPS:	__ Next Day	__ 2-Day	__ Std (1-2 day in Fla.)
__ USPS:	__ Eagle Service	__ First Class	__ Other. _____
__ Bus: type service? _____		__ Other _____	

Kits shipped by _____ on ___/___/___ to arrive ___ on ___ by ___/___/___ ___AM ___PM

OTHER NOTES:

Figure 7-1
SAMPLE KIT PREP & SHIPPING REQUEST FORM

SOURCE: ESE

ENVIRONMENTAL SCIENCE & ENGINEERING, INC.

94132780-1228

ESE SHIPPING REQUEST

DATE: _____

FROM _____ EXT. _____

PROJECT/PROPOSAL/CHARGE NO.: _____

TO _____
Name

_____
Company

_____
Street Address for UPS, Federal Express-(NO P.O. Boxes)

_____
City State Zip

( ) _____
Telephone

DELIVERY TIME-PACKAGE MUST REACH DESTINATION BY:

_____ _____
Date Time

SATURDAY SERVICE REQUIRED ☐

DECLARED VALUE : _____

WEIGHT (for more than one package, see other side) _____

TYPE OF SERVICE REQUIRED

- ☐ 1st CLASS MAIL
- ☐ UPS GROUND
- ☐ UPS 2-DAY
- ☐ UPS NEXT DAY
- ☐ FEDERAL EXPRESS 2-DAY
- ☐ FEDERAL EXPRESS NEXT DAY
- ☐ DHL
- ☐ OTHER _____

FORM 87201 A

Figure 7-2
ESE SHIPPING REQUEST FORM

SOURCE: ESE.

ENVIRONMENTAL SCIENCE & ENGINEERING, INC.

9413280.1229

COMP QAPP 1292 B.

KIT PICK-UP LOG

This log must be filled out whenever kits are not shipped by UPS or FED-X.

Project Name	Field Group	# of Coolers	Relinquished By/Date	Received By/Date

Figure 7-3
KIT PICK-UP LOG

SOURCE: ESE.

ENVIRONMENTAL SCIENCE & ENGINEERING, INC.

ESE SAMPLE TRACKING-- ICE CHEST CHECK OUT (A100)
PRINTED ON 17:02:17 03 DEC 1992 PAGE 1

LMP	COOLER	TO	TIME	COMMENT
[03269	COOL0267	3904076-0214-3200-	11:25	SITE ID 1 - 11 GLOVES; LOGSHEETS; PIPETTES; TRASH BAGS; 1 GALLON BARNSTEAD WATER
[01421	COOL0471	3924031G-0202-3200	16:31	SITE ID 1 - 5 ; LOGSHEETS; TRASH BAGS;
[03291	COOL0553	3924031G-0202-3200	11:25	SITE ID 1 - 19 TRASH BAGS; GLOVES; LOGSHEETS;
[03100	COOL0167	3924062-0800-3200	13:29	2 BOX(ES); 500 ML; 1 BOX(ES); 60 ML; BUBBLE WRAP
[03100	COOL0499	3924062-0800-3200	16:27	2 BOX(ES); 500 ML; 1 BOX(ES); 60 ML; BUBBLE WRAP;
[03100	COOL0217	3924062-0800-3200	16:29	1 BOX(ES)500 ML; 3 BOXES 60 ML;BUBBLE WRAP
[03100	COOL0593	3924062-0800-3200	16:30	1 BOX(ES); 1 LITER; BUBBLE WRAP;
[03100	COOL0660	3924062-0800-3200	16:30	1 BOX(ES); 1 LITER; BUBBLE WRAP;
[03100	COOL0655	3924062-0800-3200	16:30	1 BOX(ES); 1 LITER; BUBBLE WRAP;
[03100	COOL0662	3924062-0800-3200	16:30	1 BOX(ES); 1 LITER; BUBBLE WRAP;
[03100	COOL0664	3924062-0800-3200	16:30	1 BOX(ES); 1 LITER; BUBBLE WRAP;
[03100	COOL0653	3924062-0800-3200	16:30	1 BOX(ES); 1 LITER; BUBBLE WRAP;
[03100	COOL0629	3924062-0800-3200	16:30	1 BOX(ES); 1 LITER; BUBBLE WRAP;
[03100	COOL0550	3924062-0800-3200	16:31	1 BOX(ES); 1 LITER; BUBBLE WRAP;
[03100	COOL0472	3924062-0800-3200	16:31	1 BOX(ES); 1 LITER; BUBBLE WRAP;
[03100	COOL0267	3924062-0800-3200	16:31	1 BOX(ES); 1 LITER; BUBBLE WRAP;
[01421	COOL0344	3924079G-0201-3200	16:48	6 SODIUM HYDROXIDE; TRASH BAGS; GLOVES; LOGSHEETS; PH STRIPS; PIPETTES; EVIDENCE TAPE;SITE IDS
[01421	COOL0484	3924079G-0201-3200	16:48	SITE ID 14 ; LOGSHEETS; TRASH BAGS;
[01421	COOL0154	3924079G-0201-3200	16:49	SITE ID 15 ; TRASH BAGS; LOGSHEETS; LOGSHEETS;
[01421	COOL0156	3924079G-0201-3200	16:51	SITE 16 ; TRASH BAGS; LOGSHEETS;L0001
[01421	COOL0117	3924079G-0201-3200	16:51	SITE ID 17 ; TRASH BAGS; LOGSHEETS;
[01421	COOL0613	3924079G-0201-3200	16:52	SITE ID 18; TRASH BAGS; LOGSHEETS;
[01421	COOL0170	3924079G-0201-3200	16:52	SITE ID 19 ; TRASH BAGS; LOGSHEETS;
[01421	COOL0669	3924079G-0201-3200	16:53	SITE ID 20 ; TRASH BAGS; LOGSHEETS;
[01421	COOL0431	3924079G-0201-3200	16:54	SITE ID 21 ; TRASH BAGS; LOGSHEETS;
[01421	COOL0457	3924079G-0201-3200	16:54	SITE ID 22 ; TRASH BAGS; LOGSHEETS;
[01421	COOL0670	3924079G-0201-3200	16:55	SITE ID 23 ; TRASH BAGS; LOGSHEETS;
[01421	COOL0671	3924079G-0201-3200	16:55	SITE ID 24 ; TRASH BAGS; LOGSHEETS;
[01421	COOL0165	3924079G-0201-3200	16:56	SITE ID 25 ; TRASH BAGS; LOGSHEETS;
[01421	COOL0672	3924079G-0201-3200	16:57	SITE ID 26 ; TRASH BAGS; LOGSHEETS;
[01421	COOL0090	3924079G-0201-3200	16:57	SITE ID 27 ; TRASH BAGS; LOGSHEETS;
[01421	COOL0674	3924079G-0201-3200	16:58	SITE ID 28 ; TRASH BAGS; LOGSHEETS;
[01421	COOL0149	3924079G-0201-3200	16:58	SITE ID 29 ; TRASH BAGS; LOGSHEETS;
[01421	COOL0638	3924079G-0201-3200	16:59	SITE ID 30 ; TRASH BAGS; LOGSHEETS;
[01421	COOL0456	3924079G-0201-3200	16:59	SITE ID 31 ; TRASH BAGS; LOGSHEETS;
[01421	COOL0400	3924079G-0201-3200	16:59	SITE ID 32 ; TRASH BAGS; LOGSHEETS;

[03269 : VALRIE MCWILLIAMS
[01421 : ALFREDA MOORE
[03291 : DONNA CREWS
[03100 : DELORES DARLING
3904076-0214-3200 : -
3924031G-0202-3200 : 3924031G-0202-3200- , MARK SKROBACZ, ESE INC, 250-A EXCHANGE PLACE, HERDON, VA. VA.
3924062-0800-3200 : 3924062-0800-3200- ATTN: UMATILLA D & M, DAVIS & MOORE (KEVIN PERRETTE), UMATILLA ARMY DEPOT, BLDG 11, HERMI
3924079G-0201-3200 : 3924079G-0201-3200- ATTN: RARITAN, KEITH WARD, HOLIDAY INN, 125 RARITAN CENTER PARKWAY, EDISON NJ

Figure 7-4
EXAMPLE OF COOLER TRACKING REPORT

SOURCE: ESE

ENVIRONMENTAL SCIENCE & ENGINEERING, INC.

9413280.1231

Environmental Science & Engineering, Inc. 12-23-92 *** FIELD LOGSHEET *** FIELD GROUP: EXAMPLE
PROJECT NUMBER 3924000V 0000 PROJECT NAME: COMPANY XXX LAB COORD. PORTIA PISIGAN

ESE #	SITE/STA	HAZ?	FRACTIONS(CIRCLE)	DATE	TIME	PARAMETER LIST
*1	MW-1		EC EC VP VP VP			W610LC
*2	MW-2		EC EC VP VP VP			W610LC
*3	MW-3		EC EC VP VP VP			W610LC
*4	MW-4		EC EC VP VP VP			W610LC
*5	MW-5		EC EC VP VP VP			W610LC
*6	MW-6		EC EC VP VP VP			W610LC
*7	MW-7		EC EC VP VP VP			W610LC
*8	MW-8		EC EC VP VP VP			W610LC
*9	MW-9		EC EC VP VP VP			W610LC
*10	MW-10		EC EC VP VP VP			W610LC

NOTE -CHANGE OR ENTER SITE ID AS NECESSARY; UP TO 9 ALPHANUMERIC CHARACTERS MAY BE USED
-CIRCLE FRACTIONS COLLECTED. ENTER DATE,TIME,FIELD DATA (IF REQUIRED), HAZARD CODE AND NOTES
-HAZARD CODES: I-IRRITABLE C-CORROSIVE R-REACTIVE T-TOXIC WASTE H-OTHER ACUTE HAZARD; IDENTIFY SPECIFICS IF KNOWN
-PLEASE RETURN COMPLETED LOGSHEETS WITH SAMPLES TO Environmental Science & Engineering, Inc.

RELINQUISHED BY: (NAME/ORGANIZATION/DATE/TIME)	VIA:	REC'D BY (NAME/ORGANIZATION/DATE/TIME)
1		
2		
3		

SAMPLER: Shipped on Ice? Yes/No; I anticipate shipping ____ (#) more samples on ___/___
SAMPLE CUSTODIAN: Custody Seals Used? Yes/No; If Yes, Seals Intact? Yes/No Interior Temp? ___Deg C
Preservatives Audited? Yes/No Any Problems? Yes/No; If Yes, describe:

Figure 7-5
CHAIN-OF-CUSTODY FIELD LOGSHEET

SOURCE: ESE

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7.1.3 DOCUMENTATION

The records for laboratory sample custody include:

1. Laboratory Forms:

   Sample Kit Request Form (Figure 7-1),
   ESE Shipping Request Form (Figure 7-2),
   Kit Pick-Up Log (Figure 7-3),
   Example of Cooler Tracking Report (Figure 7-4),
   Sample Label (Figure 7-6),
   Standardized Sample Preservation Codes (Figure 7-7),
   Sample Chest Custody Form (Figure 7-8),
   Cold Room Sample Arrival Logbook (Figure 7-9),
   Sample Check In/Out Log (Figure 7-10),
   VOA GC Sample Thru-Log (Figure 7-11),
   VOA GC/MS Sample Thru-Log (Figure 7-12),
   Radiochemistry Sample Storage and Custody Logsheet (Figure 7-13),
   Conductivity Meter Calibration Form (Section 9.0), and
   pH Meter Calibration Form (Section 9.0).

2. Sample Extraction Log (Organic Laboratory/Extraction Logsheet, Figure 7-14).

Errors in all documents are corrected by following the procedure in Section 7.1.2.

7.2 LABORATORY CUSTODY

Sample chests (packages/coolers) are transported to the laboratory. The deliverer will sign, date, and indicate the time of delivery, the number of packages, the Laboratory Coordinator or addressee, and any comments including visible or suspected physical condition of the packages into the Sample Chest Custody Logbook (Figure 7-8). The chests are then recorded as having been received by the laboratory in the Sample Chest Custody Logbook by the Sample Custodian.

PROJ# 3572000V 0002 MW-10
COMPANY XXX
EXAMPLE*10-VP
SAMPLER DATE TIME
COND PH
G000000

Figure 7-6
SAMPLE LABEL

SOURCE: ESE

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ESE KEY TO FRACTION CODES 5/92

	CODE	PRESERVATIVE	CONTAINER	ANALYSIS TYPE	HOLDING TIMES
AIR	AA	4 °C	Various	Various	Various
	AO	Exclude Light	Sorbent	Organic	14 Days
	AV	Exclude Light	Charcoal	Volatiles	14 Days
	FI	Keep Upright	Cassette	Various	Various
SOILS	SS	4 °C	G. 500 mL	All excluding VOAs	7-28 Days
	SV	4 °C	G. 60 mL	Volatiles	7-14 Days
WATER	AL	4 °C (T)	G. 2x60 mL*	Carbamates,EPA531	14 Days
	B	4 °C; NaOH, pH>12	P. 1-4 L**	Cyanides	14 Days
	C	4 °C	P. 1-4 L	Various Inorganics	1-28 Days
	CL	4 °C	G. 1-4 L	Chlorophyll	1 Day
		(Preferred Filtered & Frozen at <0-Deg-C)			
	EC	4 °C (T)	G. 1 L	Chlorinated Pesticides	7 Days
	ED	4 °C (T)	G. 2x60 mL*	EDB, DBCP	14 Days
	F		P. 4 L	Collection prior to Field Filtering	
	FI	4 °C (T)	G. 1 L	GC/FI Organic	7 Days
	FM	Formaldehyde	P/G. 500mL	"Quats"	28 Days
	FP	4 °C (T)	G. 3x60 mL*	GC/FP Organic	14 Days
	H	Zn Acetate,NaOH,pH>10	P. 1 L	Sulfides	7 Days
	HB	4 °C (T)	G. 1 L	Chlorinated Herbs	7 Days
	IC	4 °C	G. 1 L	IMPA	40 Days
	LC	4 °C	G. 1 L	HPLC Organics	7 Days
	M	4 °C (T),excl. light	P. 250 mL	Bacteriologic	6 Hours
	MS	4 °C (T)	G. 1 L	GCMS-SVOCs	7 Days
	N	HNO_3, pH<2	P. 1 L	Metals (Total)	180 Days
				Mercury (Total)	28 Days
	NF	HNO_3, pH<2	P. 1 L	Metals (Dissolved)	180 Days
				Mercury (Dissolved)	28 Days
	NC	4 °C	G. 1 L	Nitrocellulose	7 Days
	NP	4 °C	G. 1 L	GC/NP Organic	7 Days
	O	4 °C; H_2SO_4, pH<2	G. 1 L	Oil & Grease, TRPH	28 Days
	OC	4 °C; H_2SO_4, pH<2	G. 250 mL	TOC (USATHAMA)	28 Days
	OD	4 °C	G. 1 L	Odor	2 Days
	R	HNO_3, pH<2	P. 1-4 L	Radionuclides	180 Days
	S	4 °C; H_2SO_4, pH<2	P. 1 L	Nutrients, TOC	28 Days
	(OP)	4 °C (T)	G. 1 L	Pest (Antiquated)	7 Days
	V	4 °C (T)	G. 4x60 mL*	VOCs,excl. Aromatics	14 Days
	VP	4 °C; HCL, pH<2(T)	G. 4x60 mL*	VOCs,incl. Aromatics	14 Days
	(W)	4 °C (T)	G. 1 L	GC/FPD Organics	7 Days
	X	4 °C (S)	G. 2x250mL*	TOX(USATHAMA)	7 Days
	XP	4 °C, H_2SO_4, pH<2(S)	G. 2x250mL*	TOX	7 Days
	Z	4 °C; H_2SO_4, pH<2	G. 1 L	Total Phenols	28 Days
OTHER:	OL	None	G. 10-100mL	Organic-Oil	14 Days
	TS	-20 °C	Various	Frozen Tissue	Various
	BK	None	Various	Asbestos, Bulk	NA

ESE KEY TO FRACTION CODES 5/92

FOOTNOTES: (*) Add Sodium Sulfite, (Na_2SO_3) if residual chlorine present (0.1M, 1 mL/L)
(S) Add Sodium Sulfite, (Na_2SO_3) if residual chlorine present (0.1M, 1 mL/L)
* Volatiles Bottles (VOAs) With Teflon Lined Rubber Septa
** Test for presence of sulfide and follow EPA procedures (below) as necessary

INSTRUCTIONS FOR SAMPLING AND SHIPPING

- Plastic (P) containers may be reused with sample. Do not reuse Glass (G)
- Fill completely, especially for volatiles (fill these slowly; achieve positive meniscus, cap, invert, check for air bubbles, cap off if needed.
- Preserve with reagents provided as mentioned above (VP's are pre-preserved)
- Special cyanide preservation: When presence of sulfide is indicated by a positive spot test with lead acetate paper, preservation consists of 1) precipitation with cadmium nitrate until a negative test is obtained, 2) filtration of the precipitate, and 3) addition of NaOH to pH > 12
- Fill out legible chain-of-custody forms. Sample Number (*) and Preserve collected, date/time of collection & shipment, appropriate field notes. Be sure to sign and date the bottom of each page where and as indicated.
- Ship with bagged ice in ice-chest by express carrier to lab coordinator's attention

Figure 7-7
STANDARDIZED SAMPLE PRESERVATION CODES

SOURCE: ESE.

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SAMPLE CHEST CUSTODY FORM

DO NOT REMOVE FROM CHECK-IN AREA

Relinquished By:					Received By:						
Time	Date	Signature	No. of Chests	Coordinator	Date	Time	Project Name	Signature	Comments *	Rads>Background Chest?	Rads>Background Sample?

* No comment means that the container was relinquished/received in good condition, properly sealed and that there was no evidence of tampering.

Figure 7-8
SAMPLE CHEST CUSTODY FORM

SOURCE: ESE.

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COLD ROOM SAMPLE ARRIVAL LOGBOOK

"DO NOT REMOVE FROM COLDROOM"

Date	Time	Project Name or Field Group	No Containers or Sample Nos.	Coordinator or Fractions	Signature	Comments

Figure 7-9
COLD ROOM SAMPLE ARRIVAL LOGBOOK

SOURCE: ESE

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ESE SAMPLE CHECK IN/OUT LOG

FIELD GROUP	SAMPLE SEQUENCE #	FRACTION	INITIALS	DEPT. #	DATE OUT	DATE IN

Figure 7-10
SAMPLE CHECK IN/OUT LOG

SOURCE: ESE

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ESE VOA GC SAMPLE THRU - LOG WEEK ENDING _____

Project Coordinator	Samples & Description	Arrival Date	Checked in by	Screen Date	Analysis Date	Complaints	Comments VOA Screen Requested

Figure 7-11
VOA GC SAMPLE THRU LOG

SOURCE: ESE.

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ESE VOA GC/MS SAMPLE THRU - LOG WEEK ENDING_____

Project Coordinator	Samples & Description	Arrival Date	Checked in by	Screen Date	Analysis Due	Complaints	Comments VOA Screen Requested

Figure 7-12
VOA GC/MS SAMPLE THRU LOG

SOURCE: ESE.

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Field Group	Sample Number	Delivery Date / Time	Check Out	Check In	Purpose of Removal
			Time / Date	Time / Date	
			Analyst	Analyst	
			Time / Date	Time / Date	
			Analyst	Analyst	
			Time / Date	Time / Date	
			Analyst	Analyst	
			Time / Date	Time / Date	
			Analyst	Analyst	
			Time / Date	Time / Date	
			Analyst	Analyst	
			Time / Date	Time / Date	
			Analyst	Analyst	
			Time / Date	Time / Date	
			Analyst	Analyst	
			Time / Date	Time / Date	
			Analyst	Analyst	
			Time / Date	Time / Date	
			Analyst	Analyst	
			Time / Date	Time / Date	
			Analyst	Analyst	

Figure 7-13
RADIOCHEMISTRY SAMPLE STORAGE AND CUSTODY LOG SHEET

SOURCE: ESE.

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ESE ENVIRONMENTAL SCIENCE & ENGINEERING, INC. | ORGANIC LABORATORY/EXTRACTION LOG SHEET

PROJECT: ______________________ EXTRACTION METHOD: ______________
PROJECT NO.: __________ CASE NO.: __________ SAMPLE FRACTION: ______________
EXTRACTOR(S): __________ CLEAN UP: __________ CHECKED BY: ______________
DATE: __________ TIME: __________ BALANCE USED: ______________

SAMPLE NO.	VOLUME-ml MASS-gr.	INITIAL/ FINAL pH	TYPE/DATE OF CLEAN UP	FINAL VOL. SOLVENT	SURRO. DATE ADDED Y/N	COMMENTS
CHAIN-OF-CUSTODY RECORD						

Figure 7-14
ORGANIC EXTRACTION LOG SHEET

SOURCE: ESE.

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ESE QAPP12.S2.B

The samples are checked in by the Sample Custodian for proper preservation (e.g., pH, temperature), integrity (e.g., leaking, broken bottles), and proper and complete sample documentation and ID. Sample chests or coolers that are not within the 4 ± 2 degrees Celsius (°C) requirement are reported immediately to the Laboratory Coordinator to determine if resampling will be required. All samples contained in the shipment are compared to the logsheet(s) to ensure that all samples designated on the logsheet have been received. Any changes in station ID from the originally established station ID are noted. The Sample Custodian will note any special remarks concerning the shipment. The Sample Custodian reviews the integrity of all sample fraction containers, checks the accuracy and clarity of all documentation received, and scans all the samples for radioactivity level. The Sample Custodian audits all fractions requiring field preservation to ensure that they have been properly preserved. The Sample Custodian will preserve unpreserved fractions or add additional preservative, if needed, on receipt. Deficiencies in sample preservation, additional preservative added, and all other inadequacies are recorded on the logsheet and reported to the Laboratory Coordinator.

All insufficiencies and/or discrepancies are recorded on the logsheet and immediately reported to the appropriate Laboratory Coordinator. The Laboratory Coordinator will inform the Project Manager and field team. The Project Manager, upon consultation with the Project QA Coordinator, may decide if resampling is required.

After all samples and documentation have been reviewed and appropriately annotated, the Sample Custodian signs the logsheet and submits it to Information Services for processing. Any marks or notes made on the chain-of-custody document by the Sample Custodian should be clearly distinguished from original field notations.

Shipping receipts are stapled on chain-of-custody logsheets and stored in the project file.

Samples are placed in appropriate storage areas in the laboratory depending on storage requirements. The Department Managers or their designee are notified that the samples have arrived through the distribution of arrival notices. The majority of the samples are

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stored in the main coldroom with the temperature maintained at 4 ± 2°C. The Sample Custodian will log the samples delivered into the coldroom in the Cold Room Sample Arrival Logbook (Figure 7-9). The coldroom is kept locked when not in use. The water samples for metals analysis (fractions N and NF) are stored in a separate air-conditioned storage room located near the metals sample preparation area. This room is also kept locked if not being used by the analyst. The samples in these storage areas are assigned to labeled shelves by field group. A sample location list is posted at the door of each storage room. Access to samples is limited to authorized personnel, and a Sample Check In/Out Log is maintained (Figure 7-10).

The samples for volatile organics are delivered directly to the gas chromatography (GC)-Volatiles or gas chromatography/mass spectrometry (GC/MS) Department by the Sample Custodian and are stored in the department's refrigerators designated for sample storage only. The samples delivered to these departments by the Sample Custodian are logged in the department's Sample Thru-Log (Figures 7-11 and 7-12). Sample fractions for volatiles are stored separate from standards or semivolatile fractions in order to minimize cross-contamination. Samples remain in storage until it is unnecessary to retain them, at which time their disposition (in accordance with Section 8.0) is noted.

The samples for radiochemistry analyses are delivered directly to the Radiochemistry Department and logged into the Sample Storage and Custody Logsheet (Figure 7-13). Samples checked out and checked in from this storage room are also documented in the Sample Storage and Custody Logsheet.

When it is necessary to use another laboratory for sample analysis, the Laboratory Coordinator is responsible for arrangements with the second laboratory. The samples will only be subcontracted to a NEESA, HAZWRAP, FDER, state and federal government agency, or client-approved laboratory (as appropriate). Specific NEESA/HAZWRAP approval is required prior to subcontracting. Documentation to transfer to another laboratory must include: collection data and time, field ID, laboratory ID, date of sample preparation, and requested analyses.

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The samples should be chilled prior to and during shipment. A logsheet indicating samples and fractions sent must accompany the samples to the subcontractor. The subcontractor should sign and date the logsheet upon receipt of the samples. A copy of the signed logsheet will be returned to ESE and placed in the project file.

7.3 LABORATORY INFORMATION MANAGEMENT SYSTEM (LIMS)

CLASS™ is an automated, inhouse-developed LIMS that integrates information from sample collection, laboratory analyses, and QC requirements; and calculates, checks, stores, and reports data in a variety of formats. CLASS™ resides on a Novell Arcnet (using Novell SFT, version 2.11) IBM-PC-compatible network with 1,600 megabytes of storage and is connected to more than 80 personal computers (PCs) throughout the Gainesville chemistry laboratories and offices. CLASS™ is managed by the Laboratory Information Services Department within the Gainesville laboratory. All data from analyses performed by the laboratory are managed and stored using CLASS™.

The database is stored, processed, and retrieved using the database manager Advanced Revelation© (copyright COSMOS, Inc.). The file structure and indexing provided by Advanced Revelation© allow easy retrieval, grouping, and formatting of data. Incorporated into the system is the ability to combine field data, analytical results, and QC data and produce specially formatted project-specific reports, statistical analyses, plots, and electronic files.

CLASS™ manages the flow of samples and data through the laboratory. Prior to sampling, the Laboratory Coordinator provides information on the number of samples, site IDs, parameters to be analyzed, and estimated collection dates. This information is entered into CLASS™ and used to produce sample labels and chain-of-custody logsheets (Figure 7-5). A unique ESE number is assigned to each sample, and labels with that number and the site ID are placed on each container for that sample. At each site, samples are collected and placed in the appropriate prelabeled containers. Sampling information is recorded on the field logsheet. Samples accompanied by the field logsheet

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are sent to the laboratory where they are checked and processed by the Sample Custodian. Samples are stored in the coldroom at 4 ± 2°C. The logsheet is submitted to the Laboratory Information Services Department, where the samples, along with the date of collection and site ID, are logged into CLASS™. Logsheets are placed in the project file and maintained by Information Services.

ESE uses a combination of EPA Storage and Retrieval (STORET) numbers and company-assigned Method Codes to designate parameters required for analysis. Each STORET-method combination has its own laboratory QC requirements specific to that analytical method stored in CLASS™. A list of all required parameters is logged into the computer with each sample. This list is identified on the field logsheet for each sample.

The sampling information is entered into the computer to activate the parameter list for the samples collected and received by the laboratory. A report (Available Numbers) of samples available for each analysis indicates the number of days left before the holding time is exceeded for each method for each sample. This report is distributed daily to each analytical department, and the information also can be accessed readily from CLASS™ by the Laboratory Coordinator or any analyst in the laboratory.

CLASS™ uses a batch method for analyzing, checking QC, and calculating final results of samples. Prior to analyzing a sample batch, the analyst will designate a specified group of samples in the computer and the sample-parameter status will be updated to "IL" ("In Laboratory"). The analytical batch is assigned a unique batch control number, which is stored with all final data, to facilitate data review, QC reporting, and retrieval of original documentation.

The production of each laboratory batch usually requires several distinct activities. Instrument calibrations are entered first and includes several QC checks by CLASS™. The linear (or quadratic or logarithmic) regression equation and correlation coefficient are calculated from the calibration curve data, and the correlation coefficient is tested to determine whether it is within an acceptable range specific to the analysis. Method blank

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and control spike information are then entered, and results are calculated and checked against control limits for that method. Sample responses are entered into the batch, and final concentrations are calculated for each sample. Responses are checked to ensure that they are bracketed by the standard curve. The batch printout includes a QC summary showing the automated QC checks, such as holding times, the presence of spikes, and acceptable spike recoveries. Any discrepancies are flagged by the computer for the analyst.

The batch printout also documents that the analyst has checked data entries and provided all required documentation for the analysis. The batch printout is completed, signed, and dated by the analyst, and reviewed and signed by the Department Manager or a designated reviewer.

Analysts use the PC to reserve samples for analysis, calculate final concentrations, and interactively check calibration curves and QC results. By allowing the analyst to enter data directly and check QC and sample results, the analyst is made aware of QC problems. When the analyst has entered the curve and QC and sample data, the batch printout (including checklists), worksheets, copies of notebook pages and any other pertinent documentation (e.g., chromatograms), are placed in a file folder with the assigned batch number and submitted to Information Services. Information Services personnel process the batch in the computer to verify QC and to update the sample records and final calculated concentrations.

Each employee is assigned an individual access code for entry into CLASS™. Laboratory personnel and Laboratory Coordinators are not permitted to update sample records; this is done exclusively by Information Services. All personnel with an access code may retrieve information from the system.

Once a batch has been finalized by Information Services, the batch is locked, and data cannot be changed by the analyst. If a data change is necessary, a Batch Update Request Form (Figure 7-15) must be completed. This form requires the reason for the change.

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BATCH UPDATE

Batch # _____ Analysis _____ Dept.# _____

Request to (circle one): DEFINALIZE or CHANGE

Initiated by: _____ In Order to:

APPROVED/ACKNOWLEDGED BY:

Dept. Manager _____ Date _____

Lab Coordinator(s) _____ _____

_____ _____

_____ _____

Changes Processed by: _____ _____

UPDATED Batch Reviewed & Approved by: _____ _____

Batch Refinalized by: _____ _____

Figure 7-15
BATCH UPDATE REQUEST FORM

SOURCE: ESE.

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the approval of the Laboratory Department Manager, and the approval of the Laboratory Coordinator. The form is then submitted to Information Services, where the original batch folder is retrieved. Information Services personnel make the change, the form is stapled to the new batch printout, and the updated batch is reviewed and approved by the Laboratory Department Manager and Laboratory Coordinator.

The batch folders, with all supporting documentation, are filed chronologically by department in a secured Information Services storage room; file cabinets with project files are stored similarly. These may be signed out for review by the analysts, Laboratory Coordinators, or QA personnel. A program in CLASS™ is used to track folders that have been checked out. Batch folders and project files are kept a minimum of 5 years.

Laboratory personnel and Laboratory Coordinators use the computer to monitor the flow of data through the system. Data are accessed and reported by sampling event, project, or any subset of samples and parameters. A log of electronic transfers is kept by Information Services. CLASS™ enables the Laboratory Coordinator to:

1. Produce a variety of summary reports of analytical data;
2. Calculate parameters from analytical data (e.g., cation/anion balance);
3. Calculate statistics such as mean, maximum, minimum, and standard deviation;
4. Calculate atmospheric concentrations;
5. Produce a data file to be read into the Statistical Analysis System (SAS) for in-depth statistical analysis;
6. Summarize QC in various formats; and
7. Produce a project-specific export-data file.

Data are stored in the CLASS™ database and can be exported electronically into Lotus and DBASE files. Many client-requested formats have been developed in CLASS™ for electronic data transfer. When a client requests an electronic data transfer, a

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regularhardcopy data report is usually sent in addition to the electronic file. Copies of both electronic and hard copies are maintained in project files.

Information Services has a staff of computer programmers to maintain and modify CLASS™. Requests for new programs or changes are kept in both electronic and hardcopy files; the names of the person making the request and the programmer are included. Every change made to a program is documented electronically at the end of the program with the date, employee number of the programmer, and a brief description of the change. A summary of these changes is maintained in CLASS™ listing the programs, changes, requestors, and programmers. All program revisions are documented in a revisions file and can be reviewed anytime. Completed requests are tested by the programmer staff and then verified by the requestor.

The Laboratory QC Coordinator validates a portion of the data quarterly by recalculations from the raw values and verification that the computer is performing calculations correctly.

The QA Division routinely checks data packages including computer printouts to verify that CLASS™ data match raw data from the laboratory.

The database is backed up daily except Saturday using optical disks or equivalent high-density storage media. These disks are stored in the Information Services air-conditioned locked storage room located in a separate building. Archived electronic data are stored in special files accessible by Information Services personnel. Laboratory Coordinators can access the status of all data (including archived samples in CLASS™) and may request that sample data be restored for more thorough review.

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8.0 ANALYTICAL PROCEDURES

8.1 STANDARD PROCEDURES

Standard analytical procedures to be used for any project for chemical analysis of water and soil are referenced in Section 5.0. Laboratory Department Managers will ensure that only these standard analytical methods are employed by the staff. Standard analytical methods manuals are required for all departments, and development of the documents are ultimately the responsibility of the department managers. The methods cited in these documents will be the methods normally used. Any deviation from the standard method must be documented in the analyst notebook and approved by the department manager.

For parameters not listed, nonstandard methods may be specified by the client or developed by the laboratory. Nonstandard methods must be validated as described in Section 8.3.

8.2 NONSTANDARD METHODS VALIDATION

If other than standard analytical methods become necessary due to a change in work scope, it is necessary to validate the analytical method. The responsible department manager must establish thorough method validation so that the method selected measures the reported parameter with the necessary precision, accuracy, and detection limit and without severe interference by other constituents in the sample. Major modifications of standard methods such as extraction, preparation, and cleanup procedures and/or the application of a standard method to new analytes or matrices will require method validation. Nonstandard methods will be submitted to and state or government agency (i.e. FDER, USACE, etc) and client, if required, FDER for review and approval prior to use on samples for analyses.

The following subsections constitute the minimum requirements for initial establishment of the accuracy, precision, and detection limit of nonstandard methods.

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For each parameter of interest, seven replicate spike samples will be prepared from laboratory blank water (for water methods) or an uncontaminated "standard" appropriate matrix (for soil or tissue methods) at one appropriate analyte concentration. Spiked samples will be analyzed according to the method. An unspiked "standard" matrix blank or unspiked laboratory blank water will be analyzed. The spiking concentration should be selected such that the final extract or aliquot can be analyzed with less than tenfold dilution in the midrange of the calibration curve.

The detection limit of each parameter of interest will be determined according to the protocols described in 40 CFR Part 136 Appendix B.

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Accuracy (Recovery)--The minimum requirements for initial establishment of accuracy for nonstandard methods are as follows:

1. Calculate the found concentration for each spiked sample as follows:

   R = measured concentration = measured concentration in spiked sample minus the measured concentration in unspiked (blank) sample.

2. Calculate the percent recovery for each spiked sample as follows:

$$P = \frac{R}{S} \times 100\%$$

   where: R = measured concentration for each spiked sample, and
   S = target concentration for each spiked sample.

3. Calculate the average percent recovery and relative standard deviation of the percent recovery for the spiked "standard" samples as follows:

$$\overline{P} = \frac{P_1 + P_2 + P_3}{3} = \begin{matrix}\textit{(standard samples)} \\ \textit{average percent recovery}\end{matrix}$$

where: S_r = standard deviation of P

$$S_r = \sqrt{\frac{1}{n-1}\left[\left(\sum_{i=1}^{n} R_i^{\,2}\right) - \frac{1}{n}\left(\sum_{i=1}^{n} R_i\right)^2\right]}$$

where: n = number of recovery values, and

RS_r = relative standard deviation of P.

$$RS_r = \frac{S_r}{P} \times 100\%$$

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Precision--The minimum requirements for initial establishment of precision for nonstandard methods are as follows:

1. Calculate the RPD between each pair of replicate sample matrix spike samples.

$$RPD_1 = \frac{|R_1 - R_2|}{(R_1 + R_2)/2} \times 100$$

$$RPD_1 = \frac{|R_1 - R_3|}{(R_1 - R_3)/2} \times 100$$

$$RPD_3 = \frac{|R_2 - R_3|}{(R_2 + R_3)/2} \times 100$$

2. Calculate the average RPD for the sample matrix spikes.

$$RPD = \frac{RPD_1 + RPD_2 + RPD_3}{3}$$

Detection Limit--The detection limit of the method is the lowest sample concentration that can be reliably recovered and measured in the sample matrix with a low background level. Statistically based procedures to determine absolute method detection limits (MDLs) as described in 40 CFR Part 136 Appendix B will be used. The reported detection limit for a method will be subject to the judgment of the analyst and the department manager and should take into account background levels, instrument baseline noise, spiking recoveries, and the lowest calibration standards analyzed. In general (except for those methods where the detection limit is derived from instrument considerations), the reported detection limit for a method is determined by the lowest standard concentration analyzed, taking into consideration the sample volume or weight of sample used and the final extract volume (where applicable).

Method validation and method detection limits determination results should be recorded and submitted to the Department Manager and Project QA Supervisor (if specified) or Laboratory QA/QC Manager prior to the initiation of analysis. Before analysis begins, the department manager will assure that the method meets the performance criteria required by the project.

Once the method is validated, these initial validation data (precision and accuracy) are periodically revised, updated, and improved using the data acquired during the laboratory's routine analytical QC program.

8.3 LABORATORY GLASSWARE

Dirty glasswares are drained of solvents and rinsed with tap water, if soils or other residues are still remaining, before they are submitted to the ESE washroom for cleaning. Glasswares from the Metals and Radiochemistry Departments are always rinsed with tap water prior to submittal to the washroom.

A completed Glassware Washing Request Form (Figure 8-1) must accompany each box of glasswares brought to the ESE washroom. All laboratory glasswares (i.e., volumetric flasks, separatory funnels, extraction tubes, beakers, graduated cylinders, and others) are cleaned according to the analysis/parameter group listed in Table 8-1. These cleaning procedures are subject to change depending on the requirements of the projects. The washroom personnel perform cleaning procedures 1 through 4 listed in the table, unless otherwise directed in writing by the analyst via the Glassware Washing Request Form. Cleaned glassware for organic analyses are placed in boxes lined with fresh aluminum foil. The form is then initialled, dated, and the type of cleaning procedures performed specified by the washroom personnel. The remaining cleaning procedures are performed by the analyst.

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GLASSWARE WASHING REQUEST FORM

TO BE DONE

☐ Normal Wash 1) Hot soapy tap water wash
2) Tap water rinse
3) DI rinse

☐ Rinse with DI only!

☐ Other _____ (be specific)
_____
_____
_____

SOLVENT RINSE

☐ Acetone

☐ Other _____
_____
_____

NEEDED BY: _____
Date and Time

SPECIAL INSTRUCTIONS: _____
_____
_____
_____

REQUESTED BY: _____

THE FOLLOWING HAS BEEN COMPLETED

☐ Normal Wash

☐ Rinse with DI only!

☐ Other _____
_____
_____
_____

SOLVENT RINSE

☐ Acetone

☐ Other _____
_____
_____

COMPLETED BY _____

DATE _____

Figure 8-1
GLASSWARE WASHING
REQUEST FORM

SOURCE: ESE.

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Table 8-1. Glassware Cleaning Procedures

Analysis/Parameter	Cleaning Protocol*
Extractable Organics	1,2,3,4,5,6
Purgeable Organics (Volatiles)	1,2,3,4,7,13
HPLC Analyses	1,2,3,4,5,10
EDB, DBCP, THMS	1,2,3,4,5,8,13
Trace Metals	1,2,3,4,12
Nutrients	1,2,3,4,11
Minerals	1,2,3,4
Residues	1,2,3,4,14
Cyanide, Oil and Grease, Phenols	1,2,3,4
Petroleum Hydrocarbons	1,2,3,4,5,9
COD, BOD	1,2,3,4
Radiochemistry	1,2,3,4

Note: DBCP = 1,2-Dibromo-3-chloropropane
EDB = 1,2-Dibromoethane
HCL = Hydrochloric acid
HNO3 = Nitric acid
HPLC = High Pressure Liquid Chromatography
THMS = Trihalomethanes

*Cleaning Procedures

1. Remove all labels using sponge or acetone.
2. Wash with hot soapy water (use Liquinox soap only) using brushes to scrub inside of glasswares, stopcocks, and other small pieces if possible.
3. Rinse three times with hot tap water.
4. Rinse three times with deionized water.
5. Rinse thoroughly with pesticide grade acetone.
6. Rinse with pesticide grade Methylene Chloride.
7. Rinse with pesticide grade methanol.
8. Rinse with pesticide grade hexane.
9. Rinse with appropriate extraction solvent prior to use .
10. Rinse with pesticide grade acetonitrile and pesticide grade methanol prior to use, if needed.
11. Acid rinse with 1:1 HCL, using only metals grade HCL.
12. Acid rinse with dilute HNO3 and then with deionized water prior to use.
13. Bake at 80°C for 3-4 hours.*
14. Bake at 180°C for 3-4 hours.*

*Class A volumetric glassware should not be baked.

Source: ESE.

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8.4 LABORATORY METHOD MODIFICATIONS

Laboratory method modifications are done either to improve the method efficiency, apply a water method with the addition of appropriate sample preparation/digestion method to soils or add new compounds to an approved method. ESE has several method modifications involving the addition of new compounds to a specific EPA method(s) or applying a water method with the addition of appropriate sample digestion/extraction method to soils. These compounds are listed in Table 8-2 and their QA targets are found in Section 5.0. Method validation have been performed and the method validation packages were submitted to FDER for approval. These method validation studies were referenced in the appendices of this LCQAP. The method validation packages include precision and accuracy data, method detection limit studies, copy of the method used, and raw data. Method validation were performed on the following compounds listing the method and matrix used:

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Table 8-2. Laboratory Method Modification Compounds

Compound/Parameter	EPA Method	Matrix
Cyanide	EPA 9010	Soil
Total Organic Carbon	EPA 9060	Soil
Hexavalent Chromium	EPA 3060/7196	Soil
Total Petroleum Hydrocarbons (TRPH)	EPA 3550, 418.1	Soil
TOX	EPA 9020	Soil
Gross Alpha	EPA 3050, 9310	Soil
Gross Beta	EPA 3050, 9310	Soil
Radium 226	EPA 3050, 9320	Soil
Radium 226, alpha emitters	EPA 3050, 9315	Soil
Radium 228	EPA 3050, 9320	Soil
Freon 113	EPA 8010	Water
MTBE	EPA 8010	Water
Isodrin	EPA 8080	Water & Soil
Kepone	EPA 8080	Water & Soil
Metolachlor	EPA 8080	Water & Soil
Kelthane (Dicofol)	EPA 8080	Water & Soil
Alachlor	EPA 8140	Soil
Metribuzin	EPA 8140	Soil
EPTC	EPA 8140	Water & Soil
Butylate	EPA 8140	Water & Soil
Pebulate	EPA 8140	Water & Soil
Vernolate	EPA 8140	Water & Soil
Atrazine	EPA 8140	Water & Soil
Terbufos	EPA 8140	Water & Soil
Haxazinone	EPA 8140	Water & Soil
Famphur	EPA 8140	Water & Soil
O,O,O-Triethyl Phosphorothioate	EPA 8140	Water & Soil
Sulfotepp	EPA 8140	Water & Soil
Thionazin	EPA 8140	Water & Soil
Methylethyl ketone (MEK)	EPA 8240	Water & Soil
Methylisobutyl ketone (MIBK)	EPA 8240	Water & Soil
Acrolein	EPA 8240	Water & Soil
Acrylonitrile	EPA 8240	Water & Soil

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Table 8-2. Laboratory Method Modification Compounds
(Continued, Page 2 of 2)

Compound/Parameter	EPA Method	Matrix
Carbon disulfide	EPA 8240	Water & Soil
Acetophenone	EPA 8270	Water & Soil
4-Aminobyphenyl	EPA 8270	Water & Soil
4-Chloroaniline	EPA 8270	Water & Soil
2,6-Dichlorophenol	EPA 8270	Water & Soil
p-(Dimethylamino)azobenzene	EPA 8270	Water & Soil
7,12-Dimethylbenz(a)anthracene	EPA 8270	Water & Soil
Ethyl methanesulfonate	EPA 8270	Water & Soil
o-Cresol	EPA 8270	Water & Soil
p-Cresol	EPA 8270	Water & Soil
1-Napthylamine	EPA 8270	Water & Soil
2-Nitroaniline	EPA 8270	Water & Soil
3-Nitroaniline	EPA 8270	Water & Soil
4-Nitroaniline	EPA 8270	Water & Soil
N-Nitroso-di-n-butylamine	EPA 8270	Water & Soil
N-Nitrosomethylethylamine	EPA 8270	Water & Soil
N-Nitrosopiperidine	EPA 8270	Water & Soil
Pentachlorobenzene	EPA 8270	Water & Soil
Pentachloronitrobenzene	EPA 8270	Water & Soil
Phenacetin	EPA 8170	Water & Soil
2-Picoline	EPA 8270	Water & Soil
Pronamide	EPA 8270	Water & soil
1,2,4,5-Tetrachlorobenzene	EPA 8270	Water & Soil
2,3,4,6-Tetrachlorophenol	EPA 8270	Water & Soil
2,4,5-Trichlorophenol	EPA 8270	Water & Soil
1,3,5-Trichlorobenzene	EPA 8270	Water & Soil

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8.5 REAGENT STORAGE

The procedures for storing reagents in the laboratory are presented in (Section 6.0). All reagents are marked with date received and date opened.

8.6 LABORATORY WASTE DISPOSAL

It is important that all waste materials generated in the laboratory be disposed of promptly and properly. The following subsections describe the procedures for handling laboratory wastes.

8.6.1 LIQUID WASTES

1. In general, no chemical wastes may be disposed of in the sinks.
2. Only certain dilute acid wastes can be disposed of in the sinks.
3. Disposal of Standards and Solutions--As standards and solutions are made, the solvent, constituents, date, and initials must be put on the container. This information must be on the container before it is offered for disposal. Standards containing any amount of organic solvents must not be poured down the sink. Aqueous standards of organic or inorganic (metals, etc.) compounds must either be disposed of in the appropriate waste drum, or picked up by the waste technician.
4. Disposal of Solvent Wastes--All waste solvents should be disposed of in the red waste-solvent containers located throughout the different departments in the laboratory. Solvents should be segregated according to the designated chemical types and placed only in the appropriate waste-solvent container. The waste containers will be emptied on a regular basis. If the containers become full before then, the hazardous materials technician should be called so the containers can be emptied.

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Solvents will be segregated as follows:

Freon Waste	Chlorinated Solvents	Flammable Solvents		HPLC Solvents
Freon-112	Methylene chloride	Hexane	Benzene	Methanol
		Acetone	Toluene	Acetonitrile
	Chloroform	Pentane	Xylene	Water
	Carbon tetrachloride	Ethyl ether	Petroleum ether	Tetrahydro-furan
		Isopro-panol	Cyclohexane	Isopropanol

*Note: Isopropanol may be disposed of in either the flammable or HPLC container.

Specially marked waste cans are available in the water quality laboratory for waste Freon-112. Freon should never be disposed of with other chlorinated solvents.

Glass jugs will not be accepted for solvent waste. Solvents must be segregated as shown and put into the red waste containers. The hazardous waste technician should be called if the solvent cans should fill during the day, and they will be emptied as soon as possible.

5. Disposal of Extracted Water Samples--Water samples which have been solvent extracted should be disposed in the extracted water waste disposal drum located in each department.

8.6.2 SOLID WASTES

1. Solvent saturated solids, such as sodium sulfate saturated with methylene chloride, should be disposed of in the red solid waste cans.

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2. Soil samples which have been extracted with a solvent should be disposed of in the red solid waste cans in the laboratory. These containers have a closed lid to prevent solvent fumes from entering the laboratory air. Full containers will be collected by the hazardous waste technician on a regular basis. The contents of this container will be allowed to air dry and disposed of in the trash by the hazardous waste technician.
3. Disposal of Old or Contaminated Chemicals--Commercial chemicals that are out of date or contaminated should be left in their original containers. The label should be secured and the date and initials should be marked on the container. The hazardous materials technician should then be called to pick up the material.
4. Disposal of 1-milliliter (mL) and 5-mL Autosample Vials Containing Extracts--These are to be collected in the vial collection containers in each laboratory. The containers will be emptied on a regular basis by the hazardous waste technician. If the container should become full, call the technician to have it emptied.
5. Disposal of Additional Hazardous Material--The contents will be clearly marked on the container or on an accompanying analysis report. Again, clearly date and initial the container. Contact the hazardous materials technician for pickup and disposal.
6. Disposal of Unmarked Containers, or Unknowns--These are brought to the attention of the department manager. Unknowns should not be allowed to accumulate or be misplaced. Unknowns cannot be taken for disposal until they are identified.

8.6.3 SAMPLE WASTES

The following procedures are employed in the disposal of excess samples that have completed all necessary testing:

1. Samples stored in the coldroom will be handled as follows:
   a. Samples will be disposed of six weeks after the sampling date unless a longer storage time is authorized by the Laboratory Coordinator.
   b. Prior to disposal, a sample throw-out report will be generated by the coldroom technician and taken to the Laboratory Coordinator Project Manager for disposal authorization on each project.

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c. The Laboratory Coordinator must use the guidelines for sample disposal to determine if the sample is hazardous.

d. Nonhazardous soil samples will be disposed of by bulking them into a drum for offsite disposal. All labels on containers must be removed prior to disposal.

e. Nonhazardous water samples will be disposed by the coldroom technician in the following manner:

   1) Water samples will be bulked into the nonhazardous water waste tanks for offsite disposal.

   2) Empty sample containers should be disposed of by breaking them in the dumpster or recycle containers. Appropriate personal protective equipment (safety glasses, gloves, etc.) must be worn when breaking empty sample containers. All labels must be removed prior to disposal.

f. If samples are deemed hazardous, the Laboratory Coordinator will generate an analysis report for the involved samples. The Laboratory Coordinator's signature on this report will be the authorization for disposal of these samples. The specific compounds for which the sample is deemed hazardous should be marked. Any additional information (i.e., known contamination which was not tested for) should also be marked on the analysis report.

g. The coldroom technician will turn the samples and the analysis reports over to the hazardous waste technician.

h. The hazardous waste technician will store the samples with their report in the hazardous waste storage building until the next hazardous waste pickup.

i. During the storage time, the hazardous waste technician will combine all compatible samples to achieve the smallest overall volume.

2. Samples not stored in the coldroom will be handled as follows:

   a. The same criteria for disposal into the waste treatment system or dumpster apply to all samples.

   b. The responsible Department Manager will give a list of samples to be disposed to the appropriate Laboratory Coordinator.

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c. The Laboratory Coordinator uses the guidelines for sample disposal and his knowledge of the sample to determine if the sample should be classified as hazardous.

d. The Laboratory Coordinator will generate analysis reports for those samples deemed to be hazardous. The Laboratory Coordinator will mark the specific compounds for which the sample is hazardous on the report. The Laboratory Coordinator's signature will authorize disposal. The Laboratory Coordinator will give the throw-out list and analysis reports back to the Department Manager.

e. For those samples deemed hazardous, the Department Manager will turn the samples and a signed analysis report over to the coldroom technician for disposal.

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9.0 CALIBRATION PROCEDURES AND FREQUENCY

Calibration procedures establish the relationship between a calibration standard(s) and the measurement of that standard by an instrument or analytical procedure. At a minimum, calibration is required: (1) when an analytical method is first set up, (2) prior to the analysis of any lot or batch of samples, (3) when the instrument detector has been subject to major maintenance, or (4) when the instrument fails the calibration QC checks.

All analytical instruments are calibrated with each use. A series of standard solutions is prepared from stock standards. These standards are either purchased from various vendors in premixed solutions or prepared directly from the stock compound. The preparation of all standard solutions is documented in a standard preparation logbook. All stock standards are dated when received, opened, and prepared (laboratory). These standards are stored in designated areas and checked for expiration dates. Specific calibration requirements for major classes of analytical procedures are described in the following sections.

9.1 STANDARD RECEIPT AND TRACEABILITY

Before any standard is purchased from a supplier, traceability and safety must be considered. This includes a consideration of the standards purity. The purity of the analyte of interest must be known at least to the accuracy requirements for its measurement. The manufacturer ensures this through certification and traceability statements. All laboratory standards must be traceable to a NIST (or EPA equivalent) source. Other chemicals must have a purity specification mentioned on their labels. The safety requirements are checked with the material safety data sheets (MSDS) which are supplied by the manufacturer.

Upon receipt, the standard is cross referenced to its purchase order to confirm that what was received is what was ordered. The chemical is hand delivered (special carrying case if required) to the department manager or analyst. The standard receipt date and initials

are noted on each standard. All standards are stored in designated areas for each department (Table 8-2).

9.2 STANDARD SOURCES AND PREPARATION

All standards used in the laboratory must be traceable to a reference source to meet the accuracy requirements as outlined in Section 5.0. The concentrations of the working solutions will depend on the calibration range of each analyte of interest. A standard is a solution of an analyte of interest with verifiable accuracy which is used to evaluate that constituent in a sample.

All new standard preparations are recorded in the appropriate standard preparation logbooks. The information recorded are the standard prepared, the source and concentration of the standard, the standard lot number, date prepared, and initials of the preparer.

The protocols for standard sources and preparation are in Table 9-1. All standards should not exceed the storage (use) life for both the stock and working solutions. Each working solution and stock solution should be labeled with date prepared, initials, concentration used, and expiration date.

Secondary dilutions made from stock standards are also recorded in the standard preparation logbook. The lot number of the stock standard used and the notebook number and/or page number will also be indicated in the logbook for traceability. Table 9-1 lists the frequency of standard preparation and storage of standards by instrument group.

9.3 LABORATORY INSTRUMENTS

Calibration criteria will be required for analytical operations. All the laboratory instrumentation is listed in Table 9-2. Each of these instruments will be calibrated in a manner consistent with EPA calibration protocols and/or ESE SOPs. Calibration will be documented in a parameter notebook or the analyst's notebook.

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Table 9-1. Standard Sources and Preparation

Instrument Group	Standard Source(s)	How Received	Source Storage	Preparation from Source	Lab Stock Storage	Prep Frequency
ICAP GFAA CVAA FLAA	Various	1,000 ppm soln.	RT	Intermediate and/or Working Stock	RT RT	> 5ppm Monthly < 5ppm Daily
Autoanalyzer (NO_2, PO_4, o-Phos., CN-, TKN, NH_4+NH_3, Phenol)	Various	Neat and/or Solution	RT	Primary Working	RT RT	Monthly Semiannually (CN-) Daily (all others)
				Intermediate Working	RT RT	Daily Daily
IR	Various	Neat (oil)	RT	Combined primary Intermediate Working	RT RT RT	Quarterly Monthly Monthly
Visible Spectrophotometer UV/VIS (MBAS, CR[illegible], S[illegible], Silica)	Various	Neat	RT	Intermediate Working	Refrigerator	Semiannually and Monthly Daily
TOC Analyzer (TOC, TIC)	Baxter	Neat	RT	Intermediate	RT	Monthly
COD Reactors	Baxter	Neat	RT	Intermediate	Refrigerator	Semiannually
pH Meter	Baxter	Various Buffer Solutions	RT	Primary	RT	Monthly
Specific Ion Meter (Fluoride)	Baxter	Neat	RT	Intermediate	RT	Semiannually
Amperiometric Titrator (Acidity)	Baxter	Neat	RT	Intermediate	Refrigerator	Monthly
Turbimeter	Baxter	Formazin Solution	RT	Working	Not stored	Daily
Conductivity Bridge (Specific Conductance)	Baxter	Neat	RT	Primary Working	Refrigerator	Monthly Daily

Table 9-1. Standard Sources and Preparation (Continued. Page 2 of 2)

Instrument Group	Standard Source(s)	How Received	Source Storage	Preparation from Source	Lab Stock Storage	Prep Frequency
GC (non-VOA)	Various	Neat	Freezer	Primary	Freezer or Refrigerator	Annually
				Intermediate	Refrigerator	Annually or Semiannually
				Working	Refrigerator	Semiannually
GC (VOA)	Various (Mainly Aldrich)	Neat	Freezer	Mixed Primary	Freezer	Bimonthly
				Working	Freezer	Bimonthly
		Mixed Soln. (Early Gasses)	Freezer	Working	Freezer	Weekly
LC	Various	Neat	Freezer	Primary	Freezer	Annually
				Intermediate	Freezer	Semiannually
				Working	Freezer	Weekly
GC/MS (non-VOA)	Various (Mainly Supplco)	Mixed Soln.	Freezer	Working	Freezer	Annually/Semiannually
GC/MS (VOA)	Various (Mainly Supplco)	Mixed Soln.	Freezer	Working	Freezer	Semiannually
Radiochemistry (Counters)	Various	Soln.	RT lead lined	Working	RT Unlined but monitored	>50% decrease in activity

Note: RT = Room temperature.
IR = Infrared.

Source: ESE.

Table 9-2. List of Laboratory Instruments

Analysis Type	Number	Instrument
Gas Chromatography/ Mass Spectrometry:		
Semivolatiles	2	HP 5988 GC/MS/DS capillary direct with HP-7671 Autosampler[1] and HP 5987 GC/MS/DS capillary direct with HP-7671 autosampler[1]; both instruments share one HP RTE-6/VM HP 1000 computer system for data acquisition and reduction and have one HP 7959 304MB hard drive and one HP 7914 132MB hard drive for a total storage capacity of 463MB.
	2	HP 5970B GC/MS/DS capillary direct with HP 7673 Autosampler; both instruments share an HP RTE-A, HP 1000 computer system for data acquisition and reduction; and have two HP-7959 304MB hard drives for a total data storage capacity of 608MB.
	1	Finnigan INCOS50 GC/MS/DS capillary direct with HP 7673 Autosampler and HP 5890 gas chromatograph; uses a Data General DG-10 computer with 70MB hard drive; and has an IBM-PC/AT for second terminal.
Volatiles	2	HP 5995 GC/MS/DS[1] using packed column with jet separator interface and HP 5987 GC/MS/DS[1] using packed column with jet separator interface; attached to a Tekmar 2000 liquid sampler (LCS) and Tekmar 2016 sixteen position autosampler (ALS); both instruments share one HP RTE-6/VM, HP 1000 computer system for data acquisition and reduction with HP7920 50MB and HP 7914 132MB hard drives for a total data storage capacity of 314MB.
	1	HP 5970B GC/MS/DS with megabore column (DB-624, 30M x 0.53 mm ID with jet separator interface; attached to Tekmar 2000 LSC and Tekmar 2016 sixteen position ALS; uses a HP RTE-A, HP 1000 computer system for data acquisition and reduction with two HP 7959 304 MD hard drives for a total data storage capacity of 608MB.
	1	HP 5989 Engine GC/MS/DS with capillary direct megabore column, DB-624, 75M x 0.53 mm ID; attached to Tekmar 2000 LSC and Tekmar 2016 sixteen position ALS; uses a HP -425T Apollo workstation, HP-UX UNIX computer system for data acquisition and reduction utilizing the Target 2 and the Envisions software developed by THRU-PUT for HP; the compute system has to HP-6000 660MB hard drives for a total data storage capacity of 1.3GB.

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Table 9-2. List of Laboratory Instruments (Continued, Page 2 of 5)

Analysis Type	Number	Instrument
	1	Finnigan INCOS500 XL/E GC/MS/DS with megabore column. DB-624, 75M x 0.53 mm ID with jet separator interface and Varian 3400 gas chromatograph; attached to Tekmar 2000 LCS and Tekmar 2016 sixteen position ALS; uses Data General Eclipse MV/1000 computer with 179MB hard drive and a Compaq Desk-Pro 386/20E for second terminal.
Gas Chromatography	10	HP 5890 GC configured for automatic sampling and equipped with dual Electron Capture Detectors. Three of the GCs are attached to a HP 3350 Laboratory Data System (LDS) and 7 to a PE Nelson Data Acquisition System.
	1	HP 5890 GC configured for automatic sampling and equipped with dual Nitrogen-Phosphorus Detector. The GC is attached to a PE Nelson Data Acquisition System.
	1	HP 5890 GC configured for automatic sampling and equipped with Flame Ionization and Flame Photometric Detectors. The GC is attached to a PE Nelson Data Acquisition System.
	1	HP 5890 GC configured for automatic sampling and equipped with Photoionization, Electron Capture, and Flame Ionization Detectors. The GC is attached to a PE Nelson data Acquisition System.
	1	HP 5880 GC configured for automatic sampling and equipped with dual Electron Capture Detectors.
	2	HP 5730 GC configured for automatic sampling and equipped with Electron Capture Detectors. The GCs are attached to a PE Nelson data Acquisition System.
	1	Shimadzu GC-14A configured for automatic sampling and equipped with dual Nitrogen-Phosphorus and Flame Ionization Detector. The GCs are attached to a PE Nelson Data Acquisition System.
	2	Varian 3400 GCs configured for automatic sampling. One GC is equipped with just a Flame-Photometric Detector and the other GC with dual Flame-Photometric and Flame Ionization Detectors.

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Table 9-2. List of Laboratory Instruments (Continued, Page 3 of 5)

Analysis Type	Number	Instrument
	4	Tracor 540 GCs equipped with series mounted Photoionization and Electrolytic Conductivity Detectors. Two of the GCs are attached to a Tekmar Purge and Trap LCS 2000 sample concentrator and 16 position Tekmar ALS 2016 automatic sampler. And two of the other GCs are attached to a Tracor Purge and Trap LCS-2 sample concentrator and 10 position Tekmar ALS automatic sampler. The GCs are attached to a PE Nelson Data Acquisition System.
HPLC	1	Schimadzu SCL-6A/SIL-6A (Controller/Injector) Gradient HPLC System with LC-6A pumps (2), ABI/Kratos 520 PCRS (post-column reactor), and Beckman 110B pumps(2); equipped with SPD-551 UV Detector and RF-551 Fluorescence Detector; and attached to a PE Nelson Data Acquisition System.
	1	Shimadzu SCL-6B/SIL-6B (Controller/Injector) Isocratic HPLC System with Beckman 110B pump; equipped with ABI/Kratos 757 UV Detector; and attached to a PE Nelson Data Acquisition System.
	1	Shimadzu SCL-6B/SIL-6B (Controller/Injector) Gradient HPLC System with LC-6A pumps (2); equipped with Kratos 757 UV Detector.
	1	Shimadzu SCL-6A/SIL-6A (Controller/Injector) Isocratic HPLC System with LC-6A pump; equipped with SPD-6AV UV/Visible Detector; and attached to a PE Nelson Data Acquisition System.
	1	Shimadzu SCL-6B/SIL-6B (Controller/Injector) Gradient HPLC System with LC-6A pumps (2); equipped with SPD-6A UV Detector; and attached to a PE Nelson Data Acquisition System.
	1	Hewlett Packard 1090 with ternary gradient solvent delivery, equipped with Diode Array Detector (DAD) and 2 UV/Visible channel outputs.
	1	Shimadzu SCL-6A/SIL-6A (Controller/Injector) Gradient HPLC System with LC-6A pumps (2); equipped with SPD-6AV UV/Visible Detector, RF-535 Fluorescence Detector and Haake DI contant temperature circulating batch; and attached to a PE Nelson Data Acquisition System.

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Table 9-2. List of Laboratory Instruments (Continued, Page 4 of 5)

Analysis Type	Number	Instrument
	1	Shimadzu SCL-10A/SIL-10A (Controller/Injector) Gradient HPLC system with LC-10A pumps (2); equipped with SPD-10A UV Detector; and attached to a PE Nelson Data Acquisition System.
Metals	1	Jarrel-Ash 1100 Inductively Coupled Plasma Emission Simultaneous Spectrophotometer System.
	2	Perkin-Elmer P11 and P40 Inductively Coupled Plasma Emission Sequential Spectrophotometer System.
	2	Perkin-Elmer Model 5100 Atomic Absoption Spectrophotometer System equipped with Flame and Graphite Furnace Model HGA 600 with Zeeman Backgound Correction.
	1	Perkin-Elmer 5100 Atomic Absorption Spectrophotometer System equipped with Graphite Furnace Model HGA 600 and Zeeman Background Correction.
	1	Perkin-Elmer 3030 Atomic Absoption Spectrophotometer System equipped with Graphite Furnace and Zeeman Background Correction.
	2	Perkin-Elmer Models MHS 20 and 50B Cold Vapor Mercury Analyzer.
	1	Buck Scientific 400 Cold Vapor Mercury Analyzer.
	1	Perkin-Elmer Model 3100 Atomic Absoption Spectrophotometer equipped with Flame, Hydride Generator, and cold Vapor attachment and D_2 background correction.
	1	Perkin-Elmer FIAS-200 automatic flow injection Mercury/Hydride System with amalgamation attachment.
	1	Perkin-Elmer Model 4100 ZL Atomic Absoption Spectrophotometer equipped with Graphite Furnace and Zeeman background correction.

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Table 9-2. List of Laboratory Instruments (Continued, Page 5 of 5)

Analysis Type	Number	Instrument
Inorganics	1	Dorhman DC-190 TOC Analyzer.
	4	Dionex 4000I (2) and 2000I (2) Ion Chromatographs with autosampler.
	5	Technicon II (4) and TRACCS 800 (1) Autoanalyzer.
	3	HACH 16500 COD Reactors.
	6	Corning 125 (3) pH meters
	2	Orion 801 and 701 Specific Ion Meters with 6-position electrode switch.
	1	Perkin Elmer 1420 Scanning Infrared Spectrophotometer.
	1	Perkin-Elmer 552 UV-Visible Spectrophotometer.
	1	Baush & Lomb Spectronic 20 Visible Spectrophometer.
	1	Wallace-Tierman Amperiometric Titrator.
	3	Hach 2100A Turbidimeter
	1	Hach Ratio Turbidimeter
	8	Metler H80 (1), Metler AE160 (5), and Metler PC2000 (2) Analytical Balances
	1	Ohaus Analytical Balance
	2	Sartorius Analytical Balance
Radiochemistry	2	EG&G Berthold LB770-2 10 Channel Simultaneous Low Background Gas Flow Proportional Counter with PC Interface-2.
	1	EG&G Ortec Multichannel Analysis (MCA) System linked with one 20% High Purity Germanuim Model GEM20180 Detector, one 35% High Purity Germanium Model GEM 35185 Detector, eight EG&G Ortec Octete PC Model 1000 Detectors Alpha Spectroscopy System, and a Bicron Model P-14-W Sodium Iodide Detector.
	1	Beckman LS1801 Liquid Scintillation Detector.
	12	Ludlum Model 312 Alpha Scintillation Detectors with Model 1000 Scalers.
	1	R.J. Harvey OX-600 Biological Oxidizer System.

The other HPLC equipments we have that can be attached to any of the five HPLC systems, if needed are: RF-535 Fluorescence Detector; Raytest Ramona 5-LS Radiochemistry Detector; Beckman 110A pump; Gilson FC-80K fraction collector; Shimadzu FCV-2AH column switching valve; Waters WISP 712 autosampler; Altex 210 manual injector; and Wescan Conductivity Detector.

Specific calibration requirements for major classes of analytical procedures are described in Sections 9.3.1 through 9.3.12. If the calibration requirements of the specified analytical method are more stringent than the procedures described in this LCQAP, the method procedures will be followed.

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9.3.1 GAS CHROMATOGRAPH/HIGH PRESSURE LIQUID CHROMATOGRAPH (GC-NONVOLATILES/HPLC) CALIBRATION

Standard Curve Calibration--Initial calibration standard solutions will be prepared by sequential dilution of a single stock standard solution to cover the analytical working range of the method. These may be either composite standards of more than one analyte or single-analyte solutions. The concentrations will be adjusted to take into account the instrumental and method detection limit. A minimum of three initial calibration standard concentrations or the number of standards specified by the method covering the working range and a blank will be prepared and analyzed. The initial calibration standards and the blank will be analyzed in every analytical run. At least one calibration standard at the middle or high range of the curve will be analyzed every 20 samples and repeated at the end of the run. A QC check standard is analyzed every time new calibration standards are prepared and analyzed to verify acceptability of the new calibration standards.

The initial calibration curve will be produced by plotting the standard response for each standard versus the concentration of each standard from the initial calibration run. The concentrations of the standards may be expressed in units of mass injected or in terms of the concentration of the standard solution, if the injection volume is constant for standards and samples. QC evaluation criteria for initial calibration, recalibration, and continuing calibrations are as follows:

1. The initial calibration curve and the subsequent recalibrations possess a minimum of three points and a blank or possess the number of calibration standards specified by the method.
2. The correlation coefficient of the curve is 0.995 or greater.
3. Continuing calibration standards are within 15 percent of the same initial calibration standard for GC (25 percent for NP detector) and within 10 percent of the same initial calibration standard for HPLC.

4. The QC check standard must be within the acceptance range provided by the vendor or within 25 percent of the standard's true if a standard from a different source or lot number is used, and
5. The calibration curve brackets the response for all samples.

Corrective actions taken if these calibration QC criteria are not met are listed in Section 13.0.

The concentration (or amount) of the injected sample will be obtained by entering the response for the sample into the initial calibration curve equation and determining the sample concentration after all appropriate extract and sample dilution factors have been applied.

For Los Alamos project, calibration requirements for organochlorine pesticides and PCBs specified in CLP SOW 12/90 will be followed.

9.3.2 GAS CHROMATOGRAPH (GC-VOLATILES) CALIBRATION

Standard Curve Calibration--Calibration standard solutions will be prepared as needed by sequential dilution of a single stock standard solution (prepared every 2 months) to cover the analytical working range of the method. These may be either composite standards of more than one analyte or single-analyte solutions. The concentrations will be adjusted to take into account the instrumental and method detection limit. A minimum of three calibration standard concentrations, or the number of standards specified by the method covering the working range and a blank, will be prepared and analyzed. The calibration standards and the blank will be analyzed in every analytical run. At least one calibration standard at the middle to high range of the curve will be analyzed every 20 samples and repeated at the end of the run to ensure constant instrument response. A QC check standard is analyzed every time new calibration standards are prepared to verify acceptability of the new calibration standards. Calibration is as described in Section 9.3.1.

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9.3.3 GAS CHROMATOGRAPH/MASS SPECTROMETER (GC/MS) TUNING AND CALIBRATION

GC/MS Tuning--Daily instrument tuning will be practiced to ensure the instrument is calibrated and in proper working condition. The GC/MS will be tuned daily with decafluorotriphenylphosphine (DFTPP) for semivolatiles analysis and bromofluorobenzene (BFB) for volatiles analysis. The mass intensity specifications for BFB and DFTPP are contained in Table 9-3. For Los Alamos project, the CLP SOW 12/90 mass specifications for BFB and DFTPP will be followed. ESE performs mass calibration in conjunction with the daily instrument tuning.

GC/MS Calibration--Relative response factors for the individual compounds will be determined as follows:

$$RF = \frac{A_C \, Q_{IS}}{A_{IS} \, Q_C}$$

where:
- A = integrated area taken from the extracted ion current profile.
- Q = quantity of material.
- C = compound, and
- IS = internal standard.

Initial calibration, using a minimum of five levels of the compound, will be used to determine the instrument linearity. The average response factor (RF) will be calculated for each compound. The response factors for the System Performance Check Compounds (SPCC) must be $\geq$0.30 (0.25 for bromoform) for EPA 8240 and $\geq$0.05 for EPA 8270. The percent relative standard deviation (% RSD) will be calculated for each calibration check compound (CCC). The percent RSD of the CCCs in the initial calibration must be $\leq$30 percent ($\leq$35 percent for EPA Method 625 only).

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Table 9-3. Mass Intensity Specifications for DFTPP and BFB

Key Ions	Ion Abundance Criterion
For DFTPP*	
51	30 to 60 percent of mass 198
68	Less than 2 percent of mass 69
70	Less than 2 percent of mass 69
127	40 to 60 percent of mass 198
197	Less than 1 percent of mass 198
198	Base peak, 100-percent relative abundance
199	5 to 9 percent of mass 198
275	10 to 30 percent of mass 198
365	Greater than 1 percent of mass 198
441	Present but less than mass 443
442	Greater than 40 percent of mass 198
443	17 to 23 percent of mass 442
For BFB*	
50	15 to 40 percent of mass 95
75	30 to 60 percent of mass 95
95	Base peak, 100-percent relative abundance
96	5 to 9 percent of mass 95
173	Less than 2 percent of mass 174
174	Greater than 50 percent of mass 95
175	5 to 9 percent of mass 174
176	Greater than 95 percent but less than 101 percent of mass 174
177	5 to 9 percent of mass 176

*Reference: Test Methods for Evaluating Solid Waste, EPA-SW-846, 3rd Edition, November 1986.

Source: ESE.

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A 1-point calibration using a midlevel standard from the initial calibration will be used daily for all subsequent analysis. The RFs of the SPCC for EPA 8240 and 8270 in this continuing calibration standard must meet the minimum response factors specified for the initial calibration previously mentioned. The RFs of the calibration check compounds in this daily calibration standard should be ≤25 percent (≤20 percent for EPA Method 625 only and ≤ 30 percent for EPA Method 8270) difference from the average RFs in the initial calibration. All other analytes should have a percent difference of 30 percent. Corrective actions taken if the QC criteria for calibrations are not met are listed in Section 13.0.

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The minimum required internal standards (IS) are chlorobenzene-d5, 1,2-dichloroethane-d4, and 1,4-dichlorobenzene-d4, for volatiles and 1,4-dichlorobenzene-d4, napthalene-d8, acenapthene-d10, phenanthrene-d10, chrysene-d12, and peylene-d12 for semivolatiles. A retention time and response check will be performed on every internal standard for samples that will be analyzed. The retention time (RT) of the IS in the sample must be ≤ ± 30 seconds from the previous daily calibration. The response area of the IS in the sample should not be > factor of 2 (-50% to +100%0 from the previous calibration.

9.3.4 GENERAL INORGANIC AND ORGANIC PARAMETERS CALIBRATION

Standard Curve Calibration--This section applies to those inorganic and organic analyses procedures [ion chromatography, colorimetric, spectrophotometric, potentiometric, infrared (IR) and ultraviolet (UV) absorption, turbidimetric] that use a standard curve for calibration [except total organic carbon (TOC) and chemical oxygen demand (COD)]. Working standard solutions will be prepared by sequential dilution of a single-stock standard to bracket the analytical working range of the method. Working standard solutions may be either composite standards of more than one analyte or single-analyte solutions. The standard concentrations will be adjusted to take into account the instrument and method, upper and lower limits of linearity, and the instrumental detection limit. A minimum of three standard concentrations, or the number of standards specified by the method, covering the working range and a blank will be prepared and analyzed. The working standards and the blank will be analyzed at the beginning of every analytical run, and at least one midlevel standard, which is the continuing calibration verification

(CCV) standard. will be reanalyzed at minimum intervals of every 20 samples and at the end of the run to check for constant instrument response.

The preparation of calibration standards is verified by the analysis of the ICV solution. The initial calibration verification (ICV) is an independent standard prepared from different stock solutions than those used to prepare the calibration standards. Typically, an EPA or NIST reference is used as the ICV and is prepared according to the supplier's instructions.

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The working curve will be produced by plotting the standard response for each standard versus the concentration of each standard from the initial calibration run. QC evaluation criteria for working curves are as follows:

1. The working curve possesses a minimum of three points, or the number of standards specified by the method, and a blank;
2. The correlation coefficient of the line is 0.995 or greater;
3. The response for the CCV analyzed at minimum intervals of every 20 samples (every 10 samples for cyanide for Los Alamos project) during the run and at the end of the run is within 20 percent of true value (15 percent of true value for cyanide for Los Alamos project);
4. The ICV is within 10 percent of the element's true value; and
5. The calibration curve brackets the response for all samples.

Corrective action procedures taken if these QC evaluation criteria are not met are provided in Section 13.0. The sample concentration will be obtained by entering the response for the sample into the working curve equation and determining the sample concentration after all appropriate extract and sample dilution factors have been applied.

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9.3.5 TRACE METALS ANALYSIS CALIBRATION

Atomic Absorption Spectroscopy (AAS) Standard Curve Calibration--Working standard solutions will be prepared to include the analytical working range of the method; these solutions may be either composite standards of more than one metal or single-metal solutions. The standard concentrations will be adjusted to take into account the instrument and method, upper and lower limits of linearity, and the instrumental detection limit. A minimum of three standard concentrations, or the number of standards specified by the method, covering the working range and a blank will be prepared and analyzed. The working standards and the blank will be analyzed at the beginning of every analytical run, and at least one midlevel standard will be analyzed at minimum intervals of every 20 samples (every 10 samples for cyanide for Los Alamos project) during the run and at the end of the run to check for constant instrument response.

The calibration is verified by the analysis of the ICV solution. The ICV is an independent standard prepared from different stock solutions than those used to prepare the calibration standards. Typically an EPA or NIST reference is used as the ICV and is prepared according to the supplier's instructions. For Los Alamos project, the ICV for cynanide analysis should be distilled with the batch of samples analyzed.

The working curve will be produced by plotting the standard response for each standard versus the concentration of each standard from the initial calibration run. QC evaluation criteria for working curves are as follows:

1. The working curve possesses a minimum of three points, or the number of standards specified by the method, and a blank;
2. The correlation coefficient of the line is 0.995 or greater;
3. The response for the midlevel standard analyzed at minimum intervals of every 20 samples (every 10 samples for Los Alamos project) during the run and at the end of the run is within 20 percent of true value (10 percent of true value for GFAA for Los Alamos project);
4. The ICV is within 10 percent (20 percent for CVAA for Los Alamos project) of the element's true value; and
5. The calibration curve brackets the response for all samples.

Refer to Section 13.0 for the corrective action procedures taken if these QC evaluation criteria for calibration are not met.

The concentration of the sample is obtained by entering the response for the sample into the working curve equation and determining the sample concentration after all appropriate digestate and sample dilution factors have been applied.

Inductively Coupled Argon Plasma (ICAP) Single Point Calibration--This procedure uses a single standard concentration for each element to obtain an instrument response (emission counts) and is analyzed in every analytical run. A second single point, emission counts obtained when aspirating a blank solution (undigested, acidified DI water), is used in conjunction with the standard to calibrate the instrument in concentration units.

The calibration is verified by the analysis of an ICV solution, which is an independent standard prepared from different stock solutions than those used to prepare the calibration standards. The elemental concentrations of the calibration verification solution must be within the calibration range of the instrument and at concentrations other than those used for instrument calibration.

A multi-element interference check solution (ICS) and a method blank (acidified DI water that is carried through the digestion process) are analyzed each day prior to analyzing the samples. For Los Alamos project, the ICS will be analyzed at the beginning and end of each analysis run or a minimum of twice per 8 hour working shift, whichever is more frequent. The ICS is used to verify the correction of spectroscopic interference caused by emissions adjacent to analyte emission lines.

The CCV solution is analyzed at minimum intervals of every 20 samples (10 samples for Los Alamos project) during the run and at the end of the run to document constant instrument response. This solution contains one-half the concentration of each element present in the calibration standards. This solution may be prepared by dilution of an

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aliquot of the calibration standard or prepared as a separate solution in a manner analogous to the calibration standard preparation procedure.

QC evaluation criteria for the instrument calibration standard are as follows:

1. A calibration standard and a calibration blank are used.
2. All the values for the ICV are within 10 percent of each element's true value.
3. Values for the ICS are 20 percent of each element's true value.
4. The measured concentrations of the elements in the CCV solution, for which calibration was performed, are within 10 percent of their respective true values.

Corrective action procedures if these QC evaluation criteria are not met are provided in Section 13.0.

9.3.6 GRAVIMETRIC METHODS CALIBRATION

Two general types of analytical balances are used at ESE: (1) the more sensitive microanalytical balance, and (2) the top-loading balance. The calibration of the microanalytical balances is verified daily by weighing the following Class S and NIST-certified weights [in grams (g)]:

Weight (g)	Tolerance Limits
0.2	± 0.0005
1.0	± 0.0005
3.0	± 0.0005
5.0	± 0.0005

The calibration of the top loading balances are verified daily by weighing the following Class S and NIST-certified weights:

Weight (g)	Tolerance Limits
5	± 0.02
20	± 0.05
50	± 0.05

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The results are recorded in the instrument logbook. If these criteria are not met, the weight may be reweighed. If the criteria are not met for the second weighing, the balance is taken out of service and repaired. The Class S weights are sent to the manufacturer yearly for calibration and recertification. Two sets of Class S weights are available in-house.

Qualified service personnel calibrate the analytical balances semiannually. The semiannual calibration is documented by a tag on the instrument. A set of NIST-certified weights is used to check the calibration daily. Results are recorded in the instrument notebook.

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9.3.7 TITRIMETRIC METHODS CALIBRATION

In all cases, standard reference materials are used to calibrate the titrant and back titrant. Preparation of these materials is described in Standard Methods or other methods manuals. Known solutions of the parameter to be analyzed will be prepared and analyzed to verify titrant standardization and the analyst's ability to discern the endpoint.

9.3.8 TOC CALIBRATION

The Dohrman TOC analyzer is calibrated with a standard reference material using a single-point calibration. The standard is analyzed before beginning every analytical run. The linearity of the calibration is verified with a low-level and high-level standard to bracket the sample concentration. The linearity checks must be within 5 percent. The continuing calibration verification standard (using mid- to high-level standard) is analyzed every 10 samples and at the end of the run, and the response must be within ± 15 percent of true value.

9.3.9 COD CALIBRATION

A reference material will be used to verify the 0- and 500-mg/L reading to the standard curve developed by Hach Chemical Company for COD on a spectrophotometer using the prepared sample vials. The 500-milligrams-per-liter (mg/L) standard must be within 5 percent.

9.3.10 BOD CALIBRATION

The oxygen probe is calibrated daily according to the manufacturer's air calibration procedure. The temperature of the incubator used for the BOD analysis will be read and recorded twice daily when in use.

9.3.11 TOTAL ORGANIC HALIDES (TOX) CALIBRATION

The TOX analyzer is calibrated with a standard reference material using a 3-point calibration. The linearity of the calibration is verified with a low-level and high-level standard to bracket the sample concentration. The linearity checks must be within 5 percent. The continuing calibration verification standard (using mid- to high-level standard) is analyzed every 10 samples, and the response must be within ± 15 percent of true value.

9.3.12 RADIOCHEMISTRY CALIBRATION

In compliance with the State of Florida DHRS Radioactive Materials licensing regulations, control charts for efficiencies and backgrounds are kept for all instruments used in radiochemical counting. All standards used in the calibrations and QC spiking are either from NIST or EPA. Count rates are calculated using computer software.

Alpha/Beta Proportional Counter--The 10-chamber, low-background alpha/beta proportional counting system is calibrated for counting efficiencies of all radionuclides on an annual basis with Am-241 and Cs-137 standards. The calibration efficiencies are verified daily by counting control check samples. Results of the check samples must be within historical control limits. The alpha/beta self-absorption calibration curve for each counting chamber and the beta spillover curves are determined annually. The voltage plateau is generated annually and verified whenever the gas is changed by counting control check samples. The voltage of the check sample must be within $\pm \geq 50V$ from the operating voltage. Background is also checked prior to each analytical run, and the count rate must be within historical control limits. Historical limits for the control check standards and backgrounds are generated quarterly.

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Liquid Scintillation Counter--Calibration efficiencies of the Beckman Liquid Scintillation Counting System for specific radionuclides are performed annually. A control check sample is analyzed prior to each instrument use to verify the calibration efficiency, and count rates must be within historical control limits generated quarterly. The instrument is also calibrated prior to each run with applicable standards (tritium, C-14, Pb-210, and Ra-226) provided by the manufacturer. The H Number Quench Efficiency Correction Curve generated annually is derived from a set of quenched standards and applied to the data to account for counting efficiencies. Background measurements are performed prior to each instrument use.

Lucas Cell Readers for Ra-226 Counting--Each Lucas Cell and the 12 matching cell readers are calibrated with known Ra-226 standard annually. The performance check standard is analyzed prior to each instrument use, and count rates must be within historical control limits generated quarterly. A background check is also performed prior to each instrument use, and the reading must be $\leq$ 1 cpm.

Gamma Spectroscopy--The efficiency calibration for all geometries are performed on an annual basis. Efficiency checks are performed daily using four peaks and documented in the gamma spectroscopy daily control logbook. Energy calibration is done monthly and is checked daily using a standard source with four peaks. A resolution check for the four peaks is performed daily. Performance standards are counted prior to each instrument use, and count rates must be within historical control limits generated quarterly. Background measurements are performed weekly or prior to each instrument use.

Alpha Spectrometers-- Alpha spectrometers are calibrated annually for efficiency with known electroplated standard sources. The efficiency is verified monthly by analyzing a control check sample. The count rates of the control check sample must be within historical control limits generated quarterly. Energy calibrations of the alpha spectrometers are performed quarterly and the calibrations are verified weekly using the control check sample. The control check sample must be within historical control limits. Detectors are checked for performance weekly by counting standard sources, and count rates must be within historical control limits generated quarterly. Background

measurements are performed weekly, and the count rate must be $\leq$ 0.02 cpm in any channel.

9.3.12.1 TRACER AND CARRIER RECOVERY ACCEPTANCE CRITERIA

All alpha activity measurements by alpha spectrometry require the use of another isotope of the same element as a tracer. A known activity of the tracer is added to the sample at the beginning of the analysis and subsequently measured by alpha spectrometry. Recovery of this tracer should be at least 50%. Samples with tracer recoveries less than 50% require reanalysis.

Analysis of other radionuclides require the addition of other elements as chemical carriers. The following is a list of the common chemical carriers used for the listed isotopes and their required minimum percent recoveries:

Radium-228

Yttrium Carrier	50% Recovery
Barium Carrier	50% Recovery

Strontium-89/90

Yttrium Carrier	50% Recovery
Barium Carrier	50% Recovery

Lead-210

Lead Carrier	50% Recovery
Bismuth Carrier	50% Recovery

Uranium-234, 235/236, 238

Uranium-232 Carrier	50% Recovery

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Thorium-227, 228, 230, 232
Thorium-234 Carrier 50% Recovery

Plutonium-238, 239/240, 241
Plutonium-242 Carrier 50% Recovery

Polonium-210
Polonium-209 50% Recovery

Americium-241
Americium-243 Carrier 50% Recovery

Samples with carrier recoveries less than the above minimum recoveries require reanalysis.

9.3.13 pH CALIBRATION

Calibrate the pH meter with three buffer solutions at pH 4, 7, and 10 prior to use. Set the pH meter temperature selector to ambient temperature. Place the probe on the pH 7 buffer and adjust the calibration switch until it reads 7.00. Repeat the procedure with the pH 4 buffer solution. Read the pH of the pH 10 buffer solution. It should be 10 ± 0.05; if not, check the pH probe and internal solution and repeat the calibration procedure.

9.3.14 SPECIFIC CONDUCTIVITY CALIBRATION

Calibrate the instrument with 0.01 M and 0.10 M KCL solutions. The conductivity reading of the 0.01 M KCL must be 1.413 umhos ± 15% and the 0.10 M KCL 12.900 ± 15%. If the calibration standards are outside the acceptance criteria, prepare new standards and recalibrate the instrument.

9.3.15 PENSKY-MARTENS CLOSE-CUP TESTER CALIBRATION

Determine the ignitability of the p-xylene standard prior to use of the Pensky-Martens Close-Cup Tester. The standard should ignite at 27.2 ± 1°C. If not, check the

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condition and operation of the apparatus, especially the tightness of the lid, the action of the shutter, and the position of the test flame. After adjustment, repeat the test with the p-xylene standard. Read and record the barometric pressure at the time of analysis.

9.3.16 DISSOLVED OXYGEN CALIBRATION

The dissolved oxygen probe should be calibrated daily or prior to use in saturated air by moving the calibration knob such that the reading is at the appropriate saturation value indicated on the instrument. Read and record the temperature at the time of reading.

9.4 STANDARDIZATION OF TITRATION SOLUTIONS

All titrants used in the laboratory are standardized against a primary standard. This ensures that the normality of the standard being used is at the correct level. Table 9-6 lists the solutions that require standardization, the standards used, and the frequency of standardization.

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Table 9-4. Standardization of Titrating Solutions

Solutions Req.	Primary Standard Source	Frequency of Standardization
Chloride:		
Silver nitrate	Sodium chloride	Every run
Alkalinity:		
Sulfuric acid	Sodium carbonate	Every run
Sulfite:		
Potassium iodide-iodate	Sulfamic acid	Every run
Hardness:		
EDTA	Calcium carbonate	Every run

Source: ESE.

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10.0 PREVENTIVE MAINTENANCE

To minimize the occurrence of instrument failure and other system malfunctions, a preventive maintenance program for laboratory instruments is implemented. Routine maintenance is performed as needed depending on how often the instrument is used. There are some parts of the instrument that will wear out faster and therefore will require replacement more frequently than the others. These wearable or expendable parts are kept in supply and evaluated during analysis. The major instrumentation in the laboratory is covered by the manufacturer's service contracts or agreements.

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10.1 DOCUMENTATION

All maintenance performed on the instruments are documented in each instrument's maintenance logbook which is kept with the instrument. The date, initials of the analyst performing the maintenance, and the type of maintenance performed are recorded in this maintenance logbook. Receipts from the routine maintenance performed by the manufacturer's representative are kept in folders and filed in the department's file cabinets. Preventive maintenance for each major piece of laboratory equipment is listed in Table 10-1.

10.2 CONTINGENCY PLAN

In the event of instrument failure, every effort will be made to analyze samples within holding times by alternate means. If the redundancy in equivalent instrumentation is insufficient to handle the affected samples, efforts will be made to secure the same or equivalent analyses by a Navy, HAZWRAP, USACE or FDER-approved laboratory, when required. The Project Manager will be advised of any required changes in methodology or location; the Project Manager should then notify the state or government agency or the client.

Table 10-1. Preventive Maintenance

Instrument	Activity	Frequency
Gas Chromatographs	Change septums	Weekly or as needed
	Check carrier gas	Daily
	Change carrier gas	As needed (when pressure falls below 100 psi)
	Cut off edge of a capillary column	As needed
	Replace oxygen traps used in the gas lines	Annually or as needed
	Clean ECD	Annually or as needed
	Replenish Electrolytic Conductivity Detector	Monthly or as needed
	Clean detectors	Annually or as needed
	Check system for gas leaks	At each column change
High Performance Liquid Chromatographs	Replace piston seals	Quarterly
	Replace or rebuild the the check valves	As needed (when performance of the instrument decreases)
	Clean detector flow cell	As needed
	Check pumps	As needed
	Replace guard column frits	As needed (when the HPLC system pressure increases)
	Clean detectors	Annually or as needed
Gas Chromatograph/Mass Spectrometer	Clean source and system	As needed
	Cut off ends of capillary columns	As needed
	Change columns	As needed
	Change injection point lines	Monthly or as needed
	Routine maintenance performed by the manufacturer	Annually
Atomic Absorption Spectrophotometers (Furnace and Cold Vapor)	Clean furnace windows	Daily
	Check plumbing connections	Daily
	Change graphite tubes	Daily or as needed
	Clean sample cells	Daily
	Check gases	Daily
	Check optics	Annually (on contract)
	Change graphite contact rings	As needed
Inductively Coupled Plasma (ICAP)	Routine maintenance performed by the manufacturer	Annually (on contract)
	Clean the torch and nebulizer	Every six months or as needed
Check tubing	Daily	

Table 10-1. Preventive Maintenance (Continued. Page 2 of 3)

Instrument	Activity	Frequency
Autoanalyzers	Clean tubing	As needed
	Check tubings	Daily
	Check optics	Daily
	Clean optics	As needed
	Replace the lamp	As needed (when darkening is evident)
Colorimeter/ Turbidimeters	Check optics	Daily
	Check light source	As needed
Spectrophotometer	Routine maintenance performed by the manufacturer	Quarterly (on contract)
TOX Analyzer	Clean electrodes	Daily
	Replace all solutions	Daily
	Clean absorber module and the furnace unit	Every six months or as needed
	Clean sampler boat	Monthly
	Check gases and tubing	Daily
TOC Analyzer	Check gases and tubing	Daily
	Change pump tubes	Prior to each use
	Flush digestion tubes	After each use
Ionanalyzers/Conductivity	Check probe	Daily
	Change probe solution	As needed
Ion Chromatograph	Routine maintenance performed by the manufacturer	Every six months (on contract)
	Check system for leaks	Daily prior to each run
	Check line pressure	Daily prior to each use
	Clean conductivity cells	Every six months
	Clean injection loops	Every six months
	Change columns	As needed
	Replace tubings in the sample path	Every six months
Turbidimeter	Clean the instrument	Prior to each use
DO Meter and Probe	Check to make sure that the mechanical zero is set properly	Prior to each use
	Check DO probe membrane	Prior to each use

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Table 10-1. Preventive Maintenance (Continued, Page 3 of 3)

Instrument	Activity	Frequency
DO Meter and Probe (cont)	Replace membrane	As needed (when tears, wrinkles, or bubbles are observed)
	Replace probe	As needed
Analytical Balances	Clean the balance	Daily
	Check alignment and balance	Daily
	Routine maintenance and calibration performed by the manufacturer	Semiannually
Radiochemistry:		
Alpha/Beta Proportional Counter	Check gas flow	Daily
	Check counting chambers	Monthly or as needed
Liquid Scintillation Counter	Check counting system	Prior to each use
Alpha Spectrometer	Clean detectors	As needed
	Clean sample chambers	As needed
	Check vacuum	Daily
	Check voltage	Daily
Radon Flask Counters	Clean the face of the photomultiplier tube	Daily
	Check microswitch	Daily
Gamma Spectroscopy	Refill liquid nitrogen in the dewar for the Ge(Li) detector	Weekly
	Check all cabling to the gamma detectors	Monthly
Biological Oxidizer	Clean ladel	Prior to each use
	Clean sample boats	Prior to each use
Ovens: TS, TSS, TDS	Check temperature	Prior to use
	Calibrate thermometer	Annually
Refrigerators/Freezers	Check temperature	Daily
	Calibrate thermometer	Annually
BOD Incubator	Check temperature	Prior to use
	Calibrate thermometer	Annually

Note: TDS = total dissolved solids. TS = total solids. TSS = total suspended solids.

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11.0 QC CHECKS, ROUTINES TO ASSESS PRECISION AND ACCURACY, AND CALCULATION OF METHOD DETECTION LIMITS

11.1 INTERNAL QC CHECKS

Analytical QC procedures are those steps taken by the laboratory in day-to-day activities to achieve the desired accuracy, precision, reliability, and comparability of analytical data. Each Laboratory Department Manager and coordinator is responsible for performing the analysis in accordance with the defined quality control practices outlined in this LCQAP.

For all analyses performed by ESE, the QC checks described in this section are mandatory unless alternate procedures are given in the specific project QA Plan or otherwise agreed upon by the Laboratory Coordinator and the Project QA Officer. Table 11-1 summarizes minimum QC sample requirements. If method QC requirements are more stringent than those listed in Table 11-1, the method requirements will be followed. Sections 3.0 and 5.0 contain QC evaluation criteria for laboratory methods and calibrations. Section 11.4 describes precision and accuracy calculations used to control samples. Laboratory Department Managers are responsible for reviewing QC criteria for each method performed by their department. Permanent changes to the acceptance criteria must be approved by the Laboratory Department and Division Managers and will be incorporated into this document in accordance with Section 3.4, Document Control. Project-specific revisions may be documented in the specific project QA Plan (DER Form 17-160.900 for FDER projects only).

For QC purposes, the number of samples extracted and/or prepared for instrumental analysis as one group in one 24-hour periodwill constitute a batch. The number and type of QC samples specified in Section 11.0 will apply to this sample batch. For example, a group of samples that is extracted on the same day and (if required) undergoes

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Table 11-1. Minimum QC Sample Requirements'

Analysis	Standard Matrix (QC Check Standard) Blank	Standard Matrix (QC Check Standard) Spike*	Sample Matrix** Spike	Sample Matrix** Replicate Spike	Sample Replicate	Surrogate Spike	Filter Blank (as required)
INORGANIC							
'All analyses except b,e,d	5%	5%	5%	5%''''	--	--	5%
'pH, residues, specific conductivity, turbidity, dissolved oxygen	5%	--	--	--	5%	--	--
'Radiochemistry only	5%	5%	5%	5%''''	10%'''	--	5%
'TCLP	5%	5%	''	--	--	--	5%
ORGANIC							
'All analyses	5%	5%	5%''''	5%''''	--	100%'''	5%
'TCLP	5%	5%	''	--	--	100%'''	5%

Note: -- = not applicable for this analysis.

*Standard Matrix Spike (QC Check Standard) is a spike into a blank matrix which is carried through sample preparation, sample digestion or extraction to sample analysis. The blank matrix is a reagent blank for aqueous samples and a standard soil for solid matrix, if available; if standard soil is not available, spiking is done on a reagent blank. This spike is also called a QC Check Standard because the standards used to prepare the spiking solution are from a different source than those used for the calibration standards.

'Actual number rounded up to nearest whole number, i.e., 5% = 1QC for 1-20 samples; 2QC for 21-40, etc.

**Sample Matrix Spike is a spike into a sample matrix which is carried through sample preparation, sample digestion, or extraction to sample analysis.

''5%, or 1 per waste type, whichever is greater.

***Surrogate(s) will only be spiked into all environmental and QC samples if specified by the method.

'''Required for drinking water analyses and Los Alamos project only.

''''For Los Alamos project, sample matrix spike and sample matrix spike duplicate for organic analysis are not required, however, they will be analyzed if requested by the client.

''''For inorganic analysis, sample matrix duplicate is not required for Los Alamos project but will be analyzed upon request by the client.

Source: ESE.

concentration and cleanup procedures on subsequent days would be considered one sample lot for QC purposes.

For analyses where no sample extraction or preparation is required, the number of samples that can be analyzed as one set during a 24-hour period will determine the number of samples per sample lot for QC purposes.

When required by the specific project QA Plan, the Project QA Coordinator may insert into a sample lot either a spiked sample or a duplicate of a previously analyzed sample for QC purposes. The Project QA Coordinator will monitor the results of this sample to ensure that the analysis meets QA criteria for the project.

Blind QC check samples are analyzed by the laboratory semiannually to evaluate the laboratory's overall system. If the blind QC check sample data are not acceptable, results will be reported in the QA report to FDER.

Spikes will be placed into sample matrices for all analyses except pH, residues, specific conductivity, and turbidity. Samples will be split into duplicates, spiked, and analyzed. The relative-percent difference between the spike and the replicate spike will be used to assess analytical precision. Selection of the sample to be split and spiked may be made by the client or by the laboratory.

Control spikes (standard matrix spikes or QC check standards) will be placed into standard matrices for all analyses except pH, residues, specific conductivity, and turbidity. This spike will be used to control the method and verify the calibration standards, if an ICV is not analyzed. A sample replicate will be prepared and analyzed for pH, residues, specific conductivity, and turbidity. The relative-percent difference between the sample and the replicate will be used to assess analytical precision.

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It is ESE's policy to control sample analyses on those QC criteria that are actually under the control of the technicians and analysts performing the analytical procedure. Therefore, emphasis is placed on calibration, method blanks, and QC check standard (standard matrix spike) results. When these are within criteria, acceptable method performance is documented. Sample matrix spikes will be reported and evaluated for precision and accuracy but not necessarily used for method control. A sample matrix spike that has recoveries outside of criteria limits will be evaluated against other available QC data within a batch to determine if the method is in control and if sample flagging is warranted. Failure of a sample matrix spike to achieve the acceptance criteria when a QC check sample in the same batch has acceptable recoveries often documents only that the method employed is not applicable to that particular matrix, not that the method is out of control.

In the following subsections, those criteria marked with an asterisk (*) will be used to control the sample analysis. Precision and spike recovery checks are discussed in further detail in Section 11.4. In addition to the QC samples specified in the following subsections, field QC blanks must be prepared and analyzed as described in Section 11.1.

11.1.1 GC/MS MINIMUM QC

For GC/MS analyses, the following minimum QC checks will apply, except for CLP SOW:

1. All samples spiked with surrogates.
2. At least 5 percent spikes in sample matrix (MS) with selected analytes and surrogates will be analyzed (analyzed only if requested for Los Alamos project).
3. At least 5 percent duplicate spikes in sample matrix (MSD) with selected analytes and surrogates will be analyzed (analyzed only if requested for Los Alamos project).
4. At least 5 percent QC check spikes in blank matrix with selected analytes and surrogates will be analyzed.

5. At least 5 percent method blanks spiked with surrogates will be analyzed.
6. One calibration standard will be run daily. Response factors must be within 25 percent (20 percent for EPA 625) of initial calibration response factors for selected calibration check compounds. Response factors of the SPCC must be $\geq$0.05 for EPA 8270 and $\geq$0.30 for EPA 8240 (0.25 for bromoform)
7. Instrument tuning protocols will be performed and be within criteria prior to analysis.
8. Continuing calibration standard will be analyzed at a frequency of 5 percent.

11.1.2 GC AND HPLC MINIMUM QC

For GC-nonvolatiles, GC-volatiles, and HPLC analyses the following minimum requirements will apply, except for CLP SOW:

1. All samples spiked with surrogate, if specified by the method.
2. At least 5 percent spikes in sample matrix (MS) with selected analytes and surrogate(s) (if applicable) will be analyzed (analyzed only if requested for Los Alamos project).
3. At least 5 percent duplicate spikes in sample matrix (MSD) with selected analytes and surrogate(s) (if applicable) will be analyzed (analyzed only if requested for Los Alamos project).
4. At least 5 percent QC check spikes in blank matrix with selected analytes and surrogate (if applicable) will be analyzed.
5. At least 5 percent method blanks spiked with surrogates (if applicable) will be analyzed.
6. At least three standards or the number of standards specified by the method will be analyzed as a standard curve.
7. Correlation coefficient of the standard curve will be equal to or greater than 0.995.
8. Samples will be within concentration range of the standards.
9. Midlevel calibration standards will be repeated at minimum intervals of every 20 samples and at the end of a run, and response of the control analytes must be within 15 percent of initial response for GC (25 percent for NP detector) and 10 percent of initial response for HPLC.

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10. Detection limits for each parameter will be determined and checked to ensure they meet limits specified for the field group.

11.1.3 TRACE METALS--ATOMIC ABSORPTION AND ICAP SPECTROSCOPY MINIMUM QC

For each batch of samples analyzed by AAS or ICAP, the following QC checks will apply, except for CLP SOW:

1. At least 5 percent spikes in sample matrix (MS) with selected elements will be analyzed.
2. At least 5 percent duplicate spikes in sample matrix (MSD) with selected elements will be analyzed (analyzed only if requested for Los Alamos project).
3. At least 5 percent QC check spikes in blank matrix with selected elements will be analyzed.
4. At least 5 percent method blanks will be analyzed.
5. At least three standards or the number of standards specified by the method will be analyzed as a standard curve.
6. Correlation coefficient of the standard curve will be equal to or greater than 0.995.
7. Samples will be within concentration range of the standards (or of the ICAP instrument).
8. Midlevel calibration standards will be repeated at minimum intervals of every 20 samples (10 samples for Los Alamos project) and at the end of a run, and response of the control elements must be within 20 percent (10 percent for ICAP and GFAA) of true value.
9. At least 5 percent filter blanks will be analyzed with all filtered samples.
10. Detection limits for each element will be determined and checked to ensure they meet limits specified for the field group.

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11.1.4 MISCELLANEOUS METHODS MINIMUM QC

For each batch of samples analyzed by ion chromatographic, colorimetric, spectrophotometric, turbidimetric, IR, UV absorption, radiochemical, and titrimetric methods (except for pH, residues, specific conductivity, turbidity, and DO), the following QC checks will apply:

1. At least 5 percent QC check spikes in standard matrix will be analyzed.
2. At least 5 percent sample matrix spikes (MS) will be analyzed.
3. At least 5 percent duplicate control spikes in sample matrix (MSD) will be analyzed (analyzed only if requested for Los Alamos project).
4. For radiochemistry methods, at least 10 percent sample replicates will be analyzed for drinking water samples and Los Alamos project.
5. At least 5 percent method blanks will be analyzed.
6. At least three standards or the number of standards specified by the method will be analyzed as a standard curve.
7. Correlation coefficient of the standard curve will be equal to or greater than 0.995.
8. For radiochemistry methods, performance check standards will be analyzed and background checks performed at the required frequency.
9. Samples will be within concentration range of the standards.
10. Midlevel calibration standards will be repeated at minimum intervals of every 20 samples (10 samples for cyanide for Los Alamos project) and at the end of a run, and responses must be within 20 percent (10 percent for cyanide for Los Alamos project) of true value.
11. At least 5 percent filter blanks will be analyzed with all filtered samples.
12. Detection limits for analytes will be determined and checked to ensure they meet limits specified for the field group.

For each batch of samples analyzed for pH, residues, specific conductivity, turbidity, and DO, the following QC checks will apply:

1. At least 5 percent sample replicates will be analyzed.

2. At least 5 percent method blanks will be analyzed.
3. At least 5 percent filter blanks will be analyzed with all filtered samples.
4. Detection limits for analytes will be determined and checked to ensure they meet limits specified for the field group.
5. Continuing calibration standards will be analyzed at a frequency of 5 percent.

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11.2 ROUTINE METHODS USED TO ASSESS PRECISION AND ACCURACY

11.2.1 PRECISION

Precision is a measure of agreement among measurements performed using the same test procedure. Precision will be assessed for applicable parameters by calculating the RPD of two duplicate spike samples as follows:

$$RPD = \frac{|R_1 - R_2|}{(R_1 - R_2)/2} \times 100$$

where: R_1 and R_2 = concentration of Replicate Spikes 1 and 2, respectively.

This calculated RPD value is compared to the criteria specified in this LCQAP. The procedures used to determine the precision targets are listed in Table 11-2.

11.2.2 ACCURACY

Accuracy is the degree of agreement between a sample's target value (known concentration) and the actual measured value. Accuracy for this project is measured by calculating the percent recovery (R) of known levels of spike compounds into appropriate sample matrices. Percent recovery is calculated as follows:

$$R = \frac{100 \times [(Spike+Sample\ Conc.)(Sample+Spike\ Vol.) - (Sample\ Vol.)(Sample\ Conc.)]}{(Spike\ Conc.)(Spike\ Volume)}$$

The following equation is an example of how this would be calculated:

1 mL of spike with concentration of 100 ppb

10 mL of sample with concentration of 10 ppb

spiked sample concentration of 20 ppb

$$= 100 x \frac{(20)(11) - (10)(10)}{(1)(10)} = 100 x \frac{120}{100} = 120 \, percent$$

Each calculated R value is compared to the accuracy criteria listed in Section 5.0. The accuracy ranges provided in Section 5.0 are based on the mean accuracy measured or expected (based on EPA data) for each parameter plus or minus three standard deviations of the mean. The procedures used to determine the accuracy targets are listed in Table 11-2. If RPD or R values for standard spikes or sample matrix spikes within a batch do not meet acceptance criteria for QC check samples as specified in Section 5.0, results reported for samples in this batch may require flagging and/or re-analysis. The Laboratory QC Manager or designee will be notified and the necessary corrective action implemented.

11.2.3 CONTROL CHARTS OF ACCURACY

Control charts will be maintained for standard laboratory spike samples for FDER, Navy, and other specified programs. Initial control charts are prepared using historical ESE data, or are derived from published EPA method data if sufficient inhouse data are unavailable. Control chart limits are updated yearly or more often as needed using historical data.

Control charts are graphical "pictures" that demonstrate statistical control, monitor trends in a measurement process, and diagnose a measurement problem.

The formulas used to establish and maintain control charts for standard laboratory spike QC samples are as follows:

$$USL\text{-}_x = \bar{X} + 3SD$$

$$UWL\text{-}_x = \bar{X} + 2SD$$

$$LWL\text{-}_x = \bar{X} - 2SD$$

$$LCL\text{-}_x = \bar{X} - \quad 3SD$$

where:

X = mean of the recoveries of the laboratory spikes.

SD = Standard deviation of the mean.

UCL = Upper control limit.

UWL = Upper warning limit.

LWL = Lower warning limit, and

LCL = Lower control limit.

All recoveries will be plotted on the appropriate matrix-specific control charts.

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Table 11-1. Methods Used to Generate Precision and Accuracy Targets

Method	Purpose	Concentration Level	Method References
Sample Duplicate	Precision	NA	STMD2216. ASTMD 32974. 110.2, 1110. SM 2330.360.1, 150.1, 9040. 9045, 160.1. 160.1. 160.3. 900.0, 903.1, 904, 905. 908
Standard Matrix Spike (QC Check Standard)	Accuracy	Low Level	7481. 270.2. 7740. 286.2. 7911. 8240
		Mid Level	200.7. 202. 204.2. 206.2, 208.2. 210.2, 213.2. 218.1. 219.2. 220.1. 239.2. 243.2, 245.1. 249.2. 258.1. 272.2. 273.1. 279.2, 283.2. 286.2. 6010. 7020. 7041. 7060, 7091. 7131. 7191. 7201. 7200. 7210. 7421. 7460. 7470. 7471. 7480. 7610, 7770. 7841. 310.0. HACH 8000. 335.3, 9010. 300. 325.3 353.2. 9200. 350.1, 351.2. CE-81-1 P 3-201. 365.1. 370.1, 375.4. 376.2. 9030. 305.1. 405.1. 9060, 330.1. 7196. 340.2. 130.2. 413.1. 9071. 9073. 420.1. 9066. 425.1. 418.1. 9071, 9073. 9020. 900.0. 9310. 9315. 904.0, 905.0. 908.0.501.2. 504. 505. 507. 515.1. 524.2. 531.1. 601. 8010. 602. 8020. 604, 8040. 605. 606. 8060. 608. 617. 8080.610. 8310. 615. 8150. 622. 614, 8140. 624. 8240. 8260. 625. 8270. 632. 612. 8120. 619. 633. 645. 8330. UW32. LW12. 547. 630.1 (Mod)
		High Level	903.0. 9320
Sample Matrix Spike	Accuracy	Low Level	7481. 270.2. 7740. 286.2. 7911. 8240
		Mid Level	200.7. 202. 204.2. 206.2. 208.2. 210.2, 213.2. 218.1. 219.2. 220.1. 239.2. 243.2, 245.1. 249.2. 258.1. 272.2. 273.1. 279.2, 283.2. 286.2. 6010. 7020. 7041. 7060, 7091. 7131. 7191. 7201,7200. 7210. 7421. 7460. 7470. 7471. 7480. 7610. 7770. 7841. 310.0. HACH 8000. 335.3. 9010. 300. 325.3. 353.2. 9200. 350.1. 351.2. CE-81-1 P 3-201. 365.1. 370.1. 375.4. 376.2. 9030. 305.1. 405.1. 9060. 330.1. 7196. 340.2.

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Table 11-1. Methods Used to Generate Precision and Accuracy Targets (Continued, Page 2 of 2)

Method	Purpose	Concentration Level	Method References
			130.2, 413.1, 9071, 9073, 420.1, 9066, 425.1, 418.1, 9071, 9073, 9020, 900.0, 9310, 9315, 904.0, 905.0, 908.0,501.2, 504, 505, 507, 515.1, 524.2, 531.1, 601, 8010, 602, 8020, 604, 8040, 605, 606, 8060, 608, 617, 8080,610, 8310, 615, 8150, 622, 614, 8140, 624, 8240, 8260, 625, 8270, 632, 612, 8120, 619, 633, 645, 8330, UW32, LW12, 547, 630.1 (Mod)
		High Level	903.0, 9320
Sample Matrix Spike Duplicate	Precision	Low Level	7481, 270.2, 7740, 286.2, 7911, 8240
		Mid Level	200.7, 202, 204.2, 206.2, 208.2, 210.2,213.2, 218.1, 219.2, 220.1, 239.2, 243.2,245.1, 249.2, 258.1, 272.2, 273.1, 279.2,283.2, 286.2, 6010, 7020, 7041, 7060, 7091,7131, 7191, 7201, 7200, 7210, 7421, 7460,7470, 7471, 7480, 7610, 7770, 7841, 310.0,HACH 8000, 335.3, 9010, 300, 325.3 353.2,9200, 350.1, 351.2, CE-81-1 P 3-201, 365.1,370.1, 375.4, 376.2, 9030, 305.1, 405.1,9060, 330.1, 7196, 340.2, 130.2, 413.1,9071, 9073, 420.1, 9066, 425.1, 418.1,9071, 9073, 9020, 900.0, 9310, 9315, 904.0,905.0, 908.0,501.2, 504, 505, 507, 515.1,524.2, 531.1, 601, 8010, 602, 8020, 604,8040, 605, 606, 8060, 608, 617, 8080,610,8310, 615, 8150, 622, 614, 8140, 624, 8240,8260, 625, 8270, 632, 612, 8120, 619, 633,645, 8330, UW32, LW12, 547, 630.1 (Mod)
		High Level	903.0, 9320

Note: Low Level = Concentration from the reporting limit to 5 times the detection limit.
Mid Level = The mean level between the reporting limit and the upper end of the linear range.
High Level = Concentration at the upper end of the linear range.

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An out-of-control situation for accuracy control charts may be indicated by the following:

1. Any one point plots outside the control limits.
2. Any eight consecutive points plot on the same side of the mean.
3. Any six consecutive points trend in the same direction.
4. A cyclical pattern is evident.
5. Any three consecutive points plot within the control limits but outside the warning limits.

The occurrence of any of these events will be investigated: corrective actions will be taken as required to return the system to a state of statistical control. All corrective actions will be documented.

11.3 METHOD DETECTION LIMITS AND PRACTICAL QUANTITATION LIMITS

11.3.1 METHOD DETECTION LIMITS (MDLS)

The detection limit of the method is the lowest sample concentration which can be reliably recovered and measured in the sample matrix with a low background level. To determine absolute MDL, statistically based procedures are available from EPA methods. The MDL studies will be performed annually.

The detection limit is defined as follows for all measurements:

$$MDL = t_{(n-1,\ 1-\alpha,\ =\ 0.99)} \times S$$

where: MDL = method detection limit,

S = standard deviation of the replicate analyses, and

$t_{(n-1,\ 1-\alpha,\ =\ 0.99)}$ = Students t-value appropriate to a 99-percent confidence level and a standard deviation estimate with n-1 degrees of freedom.

The reporting limits in Section 5.0 are derived from MDLs.

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11.3.2 PRACTICAL QUANTITATION LIMIT (PQL)

The PQL is defined as 12 times the standard deviation that is derived from the procedures used to determine MDL.

11.4 COMPLETENESS

Completeness is not an FDER requirement but is an ESE-required objective. Completeness is defined by EPA as "a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct normal conditions" (EPA, 1980). A completeness of at least 90 percent for each parameter is the objective for this project. Following completion of the analytical testing, percent completeness will be calculated as follows:

$$\text{Completeness (\%) for parameter y} = \frac{\text{\# of valid y values reported}}{\text{\# of samples collected for analysis of y}} \times 100$$

If completeness is less than 90 percent for any parameter(s), the Project Manager will be notified immediately. The Project Manager is responsible for determining if resampling will be necessary to meet project objectives and will inform the Project QA Officer and Laboratory Coordinator of the decision.

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12.0 DATA REDUCTION, VALIDATION, AND REPORTING

12.1 DATA REDUCTION

Data transfer and reduction are essential functions in summarizing information to support conclusions. It is essential that these processes are performed accurately and, in the case of data reduction, that accepted statistical techniques are used. ESE will use its in-house-developed CLASS™ for data management.

If applicable, example calculations must be included with the analytical method to facilitate review. The entry of input data and calculations should be checked and the signature/initials of the analyst or individual entering the data and reviewer(s) should accompany all data transfers with and without reduction.

For routine analyses performed at the Gainesville Laboratory, sample response data will be entered into CLASS™ by the analyst or other designated individual(s). The computer calculates the following:

1. Linear, quadratic, or logarithmic regression line for standards,
2. Coefficients of variation for replicates,
3. Spiked recoveries,
4. Reference sample concentrations, and
5. Sample concentrations.

Linear or quadratic equations will be used to calculate final data for laboratory analyses requiring a calibration curve:

$$\text{Concentration} = \text{Intercept} + M\ (\text{Response}) + M2\ (\text{Response})^2$$

The equation used to calculate final data is dependent on the linearity of the standard curve and method of analysis.

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Purgeable organics by GC/MS are calculated as follows:

$$\text{Concentration } (\mu g/L) = \frac{(A_{xa})(Q_{is})}{(RF)(A_{is})(PV)}$$

where: A_{xa} = area from the extracted ion profile of the primary characteristic ion for the target analyte in the sample.

Q_{is} = quantity of the internal standard [nanograms (ng)].

RF = response factor (see Section 8.0).

A_{is} = area from the extracted ion profile of the primary characteristic ion of the internal standard in the sample, and

PV = purge volume (mL).

Semivolatile organics by GC/MS are calculated as follows:

$$\text{Concentration } (\mu g/L) = \frac{(A_{xa})(Q_{is})}{(A_{is})\,(RF)} \times \frac{1}{FE} \times \frac{1}{\text{volume}} \times DF$$

where: A_{xa} = area from the extracted ion profile of the primary characteristic ion for the target analyte in the sample:

A_{is} = area from the extracted ion profile of the primary characteristic ion of the internal standard in the sample:

Q_{is} = quantity of the internal standard (ng):

RF = response factor (see Section 8.0):

$$FE = \text{fraction extract analyzed} = \frac{\text{Volume injected } (\mu L)}{\text{extract volume } (\mu L)};$$

volume = volume of extracted sample (mL): and

$$DF = \text{dilution factor} = \frac{\text{final extract volume for injection (mL)}}{\text{extract volume prior to dilution (mL)}}.$$

The final data for GC/MS semivolatiles and volatiles analyses are calculated by the computer data acquisition system attached to each mass spectrometer.

QC acceptance criteria (Section 5.0) for the relative percent difference of replicate matrix spike recoveries and for the range of acceptable recoveries are electronically stored for each STORET number/method code combination. If the samples in a batch (sample lot) do not pass all the QC checks (Section 11.0), then the results reported in all samples processed in the same sample set may be considered as suspect and the analyses may need to be repeated.

Completed batch folders are stored in a secured central location arranged by departments and numerically by batch number. Strip charts, chromatograms, copies of parameter notebooks, and all other pertinent raw data and other documentation will be stored in the batch folders.

Once the data set is complete for each sampling effort, the Laboratory Coordinator organizes the information in final reports appropriate to project requirements. This Laboratory Coordinator is responsible for final QC review and release of the data.

12.1.1 THE DOCUMENTATION RECORDS

12.1.1.1 GC/HPLC

Prior to analysis, the analyst must obtain a file folder and all applicable logsheets and data sheets.

Extraction Logsheet--An extraction logsheet (Figure 7-14), filled out by the analyst performing the sample extraction, will accompany each lot of samples throughout analysis. This sheet will include at least the following data:

1. Project name and number.
2. Extractor's initials.
3. Type of sample matrix.

4. Field group name.
5. Sample numbers.
6. Date extracted.
7. Analyte group [e.g., pentachlorophenol (PCP), PAHs, OCPs].
8. Initial volume or wet weight of sample extracted.
9. Initial/final pH (water sample).
10. Extracting solvent.
11. Final volume/solvent.
12. Lot number(s) of solvent(s) used.
13. Date of cleanup (if required).
14. Notes and comments affecting the extraction procedure, and
15. Appearance of each sample.

After extraction is complete, extraction logsheets will be filed in the batch folder and accompany the extracted samples to the instrumental analyst. Each extract vial will be properly labeled and include the following information:

1. Project name.
2. Field group name.
3. Sample number.
4. Extraction concentration factor.
5. Date extracted, and
6. Extractor's initials.

Instrument Logbooks--During analysis, the following information will be recorded in the instrument notebook:

1. A log of the types of analyses run on the instrument, to include:
   a. Column conditions and temperature zones.
   b. Sample numbers or other identification of samples.
   c. Reference to a method describing the analysis.
   d. Analysis date.

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e. Detector used [e.g., flame ionization detector (FID)], and

f. Detector conditions.

2. Service records, which are kept in a separate maintenance log.

Chromatograms--At the time of analysis, the analyst will include on the chromatogram the following information:

1. Date and time of analysis.
2. Analyst's initials.
3. Instrument used.
4. Field group name.
5. Sample number and other identification for each chromatogram, and
6. Concentration/dilution factor for each sample.

The chromatograms, extraction logsheet, and copies of instrument logbooks will be placed in the batch file folder.

Chromatographic Logsheets--For each analysis, the analyst will record all pertinent information on a standard curve data sheet and chromatographic data logsheet. The standard curve data sheet lists the standards, their concentrations, and the respective responses. The chromatographic data sheet lists the samples in order of injection and the factors needed for calculating the concentrations. A sample calculation using calculated response factors will appear on the back of the chromatographic data sheet if responses are calculated manually.

After the analysis and data reduction are complete, the chromatograms and worksheets will be stored in the batch file folder and the data entered into CLASS™. The folder will be turned in to Laboratory Information Services for processing and storage in the secured central filing location.

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Standards--Prior to analysis, stock standard solutions and working solutions covering the working range of the method will be prepared. Procedures used in preparing the standards will be recorded in the standards preparation notebook. The following information must be recorded:

1. Reference standard source.
2. Lot number.
3. Date of preparation.
4. Analyst's name or initials.
5. Actual weight measured.
6. Volumetric flask volume.
7. Calculated concentration.
8. Solvent name and lot number.
9. Dilutions, and
10. Expiration date.

Immediately after an analytical standard has been prepared, the standard will be transferred to an amber glass vial or bottle and properly labeled. Standards should be refrigerated when not in immediate use.

12.1.1.2 GC/MS

Prior to analysis, the extracting analyst must obtain a batch file folder and all applicable data sheets and logsheets.

Extraction Logsheet--Once a batch has been established, the sample extraction and analysis procedure begins. A GC/MS extraction logsheet (Figure 7-14), filled out by the analyst performing the sample extraction, will accompany the batch throughout analysis. This sheet will include at least the following data:

1. Project name and number.
2. Analyst's initials.
3. Type of sample matrix.

4. Field group name.
5. Sample numbers.
6. Date extracted.
7. Analyte group (i.e., acids, base/neutrals).
8. Initial volume or wet weight of sample extracted.
9. Initial/final pH.
10. Extract solvent.
11. Final volume/solvent.
12. Lot number(s) of solvent(s) used.
13. Date of cleanup, and
14. Notes and comments affecting the extraction procedure.

After extraction, extraction logsheets will be filed in the batch file folder and accompany the extracted samples to the instrument analyst. The extract vial will be properly labeled. The label will contain the following information:

1. Project name.
2. Field group.
3. Sample number.
4. Extraction concentration factor and solvent used.
5. Date extracted, and
6. Extractor's initials.

Sample Screening--Sample extracts may be screened by GC employing flame ionization detection (GC/FID) prior to GC/MS analysis to permit dilution of extracts (as required) to concentration levels compatible with the GC/MS instrument and column capabilities.

Spectral Data and GC/MS Computer Quantitation Report--The quantitative sample and standard data generated by the GC/MS data system and all mass spectral information will be labeled according to EPA-CLP 2/88 SOW and placed in the batch file folder. Manual data reduction sheets also will be placed in this folder.

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Standards--Prior to analysis, stock standard solutions and working solutions covering the working range of the instrument are prepared. Procedures used in preparing the standards must be recorded in the preparer's laboratory notebook. The following information will be recorded:

1. Reference standard source.
2. Lot number.
3. Date of preparation.
4. Analyst's name or initials.
5. Actual weight (or volume) measured.
6. Volumetric flask volume.
7. Calculated concentration.
8. Solvent name and lot number, and
9. Dilutions.

The analytical standard will be transferred immediately to a properly labeled glass amber bottle or vial after preparation. Standards should be refrigerated when not in use.

GC/MS Instrument Logbooks--Whenever the GC/MS is used for sample analysis, the following information will be recorded in an instrument logbook:

1. Instrument conditions of the gas chromatograph.
2. Instrument conditions of the mass spectrometer.
3. Analyst's initials.
4. Date of analysis.
5. Sample number.
6. Dilution factor, and
7. Frame reference number (FRN).

Compound Identification--Compound identification will be made in terms of the full-scan mass spectrum obtained in the electron impact mode at 70 electronvolts (eV). Compound identification will require the presence of all significant major ions at the appropriate

relative abundance as obtained with an authentic compound or reference spectrum from a reputable literature source. The selection of significant ions is strongly compound dependent, and because of this and other considerations, the identification of compounds will entail considerable professional judgment and experience.

The most convincing evidence for compound identification is comparison of spectrum with that of an authentic compound obtained under identical operation conditions. When this is not possible due to compound availability, computer identification or manual library search will be used.

When no tentative matches are found in the library, identification will be based on application of known fragmentation patterns, empirical correlations, and isotope abundance data. All data reported as a result of library searches will be reported as tentatively identified compounds (TICs).

Compound Quantification--The technique of extracted ion current profiles will be employed for the preliminary qualitative searching and for quantification of individual compounds. Appropriate internal standards will be employed to permit quantification in terms of the relative response to these internal standards. Concentration calculations and data reduction procedures are given in Section 10.1.

Spiking with Internal Standards--All samples will be spiked with quantitation standards just prior to the GC/MS analysis (Section 11.2). Appropriate internal standards will be selected for the remaining categories.

GC/MS Instrumental Detection Limits--The instrumental detection limit refers to the least quantity of material required to provide a total mass spectrum of sufficient quantity to permit compound identification. The mass spectrum must contain all major ions with the appropriate relative abundance within 20 percent of either an authentic compound

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analyzed under identical conditions or an appropriate reference spectrum from the literature.

Data Management--Output from the gas chromatography/mass spectrometry/ data system (GC/MS/DS) is variable, depending on the project. However, all raw data such as mass chromatograms will be stored on magnetic tape. The final results are transmitted to CLASS™ by project and sample number. Quantification reports present the calculation results. The FRN is obtained from the quantification reports. All magnetic tapes are kept in sequential order with respect to the FRN. By following this sequence, it is possible to obtain all raw data for a particular sample number. The GC/MS computer generates a data file that is transmitted to CLASS™. Laboratory Information Services personnel process the transmitted data and generate a batch report. The batch is returned to the analyst for review. The batch folder, containing the quantification report, batch report, copies of logsheets, and other pertinent raw data is turned into Laboratory Information Services for processing and storage in the secured central filing location.

12.1.1.3 Trace Metals

Prior to analysis, the analyst must obtain a file folder and all applicable logsheets and data sheets.

Digestion or Sample Preparation Logsheet--A digestion or sample preparation logsheet, filled out by the analyst performing the sample digestion or sample preparation, will accompany each lot of samples throughout the analysis. This logsheet will include the following data:

1. Method used (GFAA, CVAA, ICAP)
2. Analyst's initials.
3. Date sample digested.
4. Initial volume or weight.
5. Final volume.
6. Spiking solution used and date spiking solution prepared.

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7. Field Group,
8. Sample numbers, and
9. Notes or comments affecting the digestion procedure.

Strip Charts--At the time of analysis (currently only applicable to mercury by cold vapor), the following information will be recorded on the strip chart:

1. Analyst's name, initials, or employee number;
2. Date of analysis;
3. Instrument/method used;
4. Element of interest;
5. Instrument conditions;
6. Sample matrix; and
7. Comments.

During analysis, the analyst will indicate on the strip chart sample numbers, QC samples, blanks, and standards.

After the data have been reduced and recorded in the instrument notebook, the strip charts are placed in a batch file folder together with the copies of the digestion logsheet, copies of the instrument logbook, and reduction sheets. These data are entered manually or automatically uploaded to CLASS™ to generate a uniquely numbered batch. The analyst reviews the data and validates the correct transcription of data into CLASS™. Then, the batch is signed and submitted to Laboratory Information Services to be stored in the secured central filing system.

For ICAP, the ICAP computer produces a data file that is evaluated and transmitted to CLASS™. The analyst then generates a batch for review. The batch folder containing the batch report, the data file, copies of logsheets, and all other pertinent raw data are turned in to Laboratory Information Services for processing and storage in the secured central filing location.

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Laboratory Notebooks--Each instrument will have its own laboratory notebook. After each analysis, the analyst will record in the notebook the following information:

1. Problems encountered during the digestion/analysis.
2. Comments about the samples and/or analytical procedure.
3. Instrument used.
4. Method used (GFAA, CVAA, ICAP).
5. Date of analysis.
6. Analyst(s).
7. Element.
8. Sample matrix.
9. Instrument conditions.
10. Field group.
11. Sample numbers.
12. QC data, and
13. Raw data.

Standards--Stock standard solutions are purchased from vendors. These stock solutions are certified by the vendor for purity and concentration.

Standard preparations are recorded in a logbook. The information recorded includes preparer's name, lot number, date of preparation, volumes used, calculated concentrations, and dilutions.

Volumetric dilutions are made from the stock solution to obtain working solutions. Serial dilutions are then made from the working solutions to obtain working standards to be used to generate standard curves. Working standard solutions are stored in volumetric flasks and properly labeled with the following information:

1. Preparer's name or initials.
2. Date of preparation.
3. Element(s).

4. Concentration, and
5. Expiration date (if not prepared daily).

12.1.1.4 Inorganics

Raw data for most inorganic analyses is documented through the use of parameter notebooks. The notebooks may vary slightly in format dependent upon the type of analysis, but, at a minimum will contain the following:

1. Analysis date.
2. Parameter.
3. STORET and method code.
4. Standard curve range and responses (where applicable).
5. Analytical batch number.
6. Instrument conditions (where applicable).
7. Method reference.
8. Sample, standard, QC sample and blank identification and responses or concentration as applicable, and
9. Analyst's signature.

Raw data for specialized instrumental analyses are documented in the following sections.

<u>Inorganic Analysis by Autoanalyzer</u>

<u>Strip Charts--The</u> following information will be recorded on the strip chart:

1. Analyst's name, initials, or employee number.
2. Date of analysis.
3. Instrument used.
4. Analytical parameter.
5. Analytical batch number.
6. Standard calibration setting.
7. Sample, standard, QC sample, and blank sample identification above appropriate peaks, with dilution factors when applicable.

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After the data have been reduced and recorded in the parameter notebook, the strip charts are placed in a batch file folder with copies of the notebook pages and any additional related information. These data are entered manually or are electronically uploaded to CLASS™ to generate a uniquely numbered batch. The batch is reviewed for correctness and signed by the analyst and submitted for peer review. When peer review is complete, the reviewer signs and submits the batch to Laboratory Information Services to be finalized and stored in the secured central filing location.

Laboratory Notebooks--Each analytical parameter has its own laboratory notebook. During analysis, the following information is recorded:

1. Date of analysis.
2. Parameter.
3. STORET and method code.
4. Batch number.
5. Instrument conditions.
6. Calibration standard setting and response.
7. Standard curve range and date of preparation.
8. Sample and QC identification numbers, and
9. Analyst's signature.

Inorganic Analysis by Ion Chromatography

Chromatograms--All information on the chromatograms from each analytical run is electronically recorded from the input provided during run set up. This information includes the following:

1. Analyst's initials;
2. Analytes;
3. Analysis date and time;
4. Instrument identification;
5. Integration parameters;
6. Sample, standard, and QC sample identification with concentrations and responses; and

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7. Dilution factors when appropriate.

These data are electronically uploaded to CLASS™ and a unique batch number is assigned. The data are reviewed by the analyst for correctness, signed and submitted for peer review. When peer review is complete, the reviewer signs and submits the batch to Laboratory Information Services to be finalized and stored in the secured central filing location.

Laboratory Notebooks-Each instrument has its own laboratory notebook. The following information is recorded in the notebook during the set up of the analytical run:

1. Analysis date.
2. Analyte.
3. STORET and method code.
4. Instrument identification and operating conditions.
5. Calibration standards and preparation dates.
6. Notes and comments as appropriate, and
7. Sample and QC sample identification numbers with dilution factors when applicable.

12.1.1.5 Radiochemistry

Instrument Logbooks--Each instrument will have its own laboratory notebook. After each analysis, the analyst will record in the notebook the following information:

1. Type of analysis being performed.
2. Name of person(s) doing the analysis.
3. Sample names and numbers.
4. Notes of GM surveys performed on samples prior to counting.
5. Background information on samples prior to counting.
5. Background information on each detector.
6. Analysis date.
7. Documentation concerning sample analysis (Did samples appear to have significant count rate?).

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8. Physical appearance of samples.
9. Flow rate of gases, and
10. Detector conditions.

Service records are maintained in a separate logbook and contain all information pertinent to calibration, cleaning, and repair of instrumentation.

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12.2 DATA VALIDATION

Unless otherwise specified by the client, the following procedures for review/validation of data are employed.

12.2.1 LABORATORY ACTIVITIES

Data review is initiated by the bench analyst upon conversion of raw data into reportable data. The bench analyst reviews preliminary data entries, calculations, holding times and precision, accuracy, and calibration checks. The analyst provides explanation and/or corrective action for any method control parameters which are outside criteria and signs the analytical batch when ready to release the data for further processing and review.

The analyst's supervisor or a designated reviewer also reviews the analytical batch documentation associated with the batch (such as sample preparation/ digestion/extraction logsheets, instrument logsheets, copy of sample preparation, etc.) and any explanations or corrective actions provided by the analyst. If the supervisor or designee is not satisfied with the explanations or corrective actions, an additional explanation or corrective action is provided in the batch. The supervisor or designee signs the analytical batch when satisfied with the data.

The Laboratory Coordinator reviews analytical data batches that have explanations and corrective actions and signs the analytical batch when satisfied with the data. The Laboratory Coordinator also reviews all final data reports for inconsistencies and

completeness prior to releasing the reports to the client; qualification or flagging, if needed, of data and/or QC summaries are provided as appropriate.

The Laboratory QA/QC Coordinator performs quarterly audits to check that required QC procedures are being followed. This procedure entails random review of analytical batches to see that the QC designated for the analysis are being consistently performed. A record of this audit is maintained by the Laboratory QA/QC Coordinator. The Laboratory QA/QC Coordinator also initiates and follows up on corrective actions to resolve QC problems.

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The minimum QA/QC data that should be included in the data batch are the following:

1. Sample data (matrix, date of extraction, and date of analysis);
2. Parameter, result, and test method identification;
3. Sample-specific detection limits for each parameter; and
4. Results of laboratory control data, method blanks, spikes, and replicates (as required).

12.3 DATA REPORTING

Data reporting is accomplished by the Laboratory Coordinator using CLASS™. The data flow scheme for CLASS™ is presented in Figure 12-1. All client data and pertinent field information are entered into CLASS™ directly from the chain of custody sheets. A copy of this information is given to the Laboratory Coordinators for verification to ensure that all pertinent information is available and correct. An example of a Results of Analysis Report is shown in Figure 12-2. CLASS™ sorts all available samples for analyses for each parameter by due date, client ID, field group, etc. Daily reports are generated by Laboratory Information Services and sent to each analytical department to notify them of samples that are due for analysis.

Each analyst who enters their analytical information directly into CLASS™ as a batch report. The analysts enter standard curves (linear, quadratic, or logarithmic), method blank and control spike data into CLASS™ to create a batch. Sample responses are entered into the batch and the final results are then calculated according to the methods specified in Section 7.0 of the CompQAP and Section 12.1. The analysts check all their data to ensure that all information is available and correct before signing the batch report. The analyst's supervisor or Department Manager then reviews the final batch report and signs it to verify that all data are accurate as reported. The batch is then finalized by Laboratory Information Services. Once a batch is finalized, the analyst or analyst's supervisor cannot change the data. Any requests for corrections are sent to Laboratory Information Services where the changes are made. The Laboratory Coordinator generates and prepares from CLASS™ the final report to the client. The Laboratory Coordinator reviews the final reports for inconsistencies and completeness. Deliverables will comply with NEESA/HAZWRAP or project specific requirements for the DQOL (Data Quality Objective Level) specified for each project. Prior to the release to the client the final report is peer reviewed using the checklist in Figure 12-3.

12.4 DATA STORAGE

A hard copy of all batch folders, supporting documents, and project files are filed chronologically by department in the secured centralized batch storage located in a separate building. The newer batch folders are also stored chronologically by department in locked file cabinets located in Information Services Department. The batch folders include copies of sample preparation/digestion/extraction logsheets, copies of instrument logsheets and standard preparation logbook pages, laboratory chain of custody, and raw data. The batch folders may be checked out for review by laboratory analysts, Laboratory Coordinators, or laboratory personnel. A program for tracking folder status and custody is available in CLASS™. This program is used to track folders that have been checked out. In addition, any personnel checking out a batch folder from Laboratory Information Services is required to sign, date, indicate the batch numbers, and department numbers on the Document Control Logbook (Figure 12-4). When the laboratory or QA personnel are finished reviewing the batch folders, they are returned to

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Laboratory Information Services and the Document Control Logbook is signed and dated. At a minimum, all project files are kept for 5 years.

The original laboratory notebooks and analysts notebooks are used until they are filled, then sequentially numbered and archived by the supervisor within each department.

All data stored in the CLASS™ database are backed up every day except Saturday using electronic optical disks or equivalent high-density storage media. Disks are stored in special files and archived in a separate building in a secured air-conditioned location.

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Sample Login	--activate samples --set permanent station codes --store collection time and date --store field data
Schedule Analyses	--list of samples available for each parameter sorted by due date
Input Results	--reserve analysis --input calibration, quality control and sample data
Quality Control	--calculate calibration curve, spike recovery, replicate and reference sample quality control
Calculate Results	--calculate and store final sample concentrations
Intersample QC	--check for data inconsistencies --perform interparameter calculations
Reports	--produce reports of sample data, quality control, and statistical analyses

Figure 12-1
FLOWCHART OF THE CLASS PROGRAM

SOURCE: ESE.

ENVIRONMENTAL SCIENCE & ENGINEERING, INC.

Environmental Science and Engineering DATE 3/01/91 STATUS: FINAL

PROJECT NUMBER: 99999 0000 PROJECT NAME: EXAMPLE PROJECT
FIELD GROUP: XXXXXXX LAB COORDINATOR: ALAN CHEMY

RESULTS OF ANALYSIS

PARAMETERS UNITS	STORET METHOD	MW5 XXXXXX 1	MW6 XXXXXX 2	MW7 XXXXXX 3	MW10 XXXXXX 4
DATE		04/13/90	04/13/90	04/12/90	04/13/90
TIME		11:15	13:00	15:00	14:00
LEAD,TOTAL UG/L	1051 GFAA	16.1	79.9	22.8	13.9
1,2-DIBROMOETHANE (EDB) UG/L	77651 EC	<0.013	0.078	<0.013	<0.013
CARBON TETRACHLORIDE UG/L	32102 HA	<1.00	<1.00	<1.00	<1.00
CHLOROBENZENE UG/L	34301 HA	<1.00	<1.00	<1.00	<1.00
CHLOROETHANE UG/L	34311 HA	<1.00	<1.00	<1.00	<1.00
CHLOROFORM UG/L	32106 HA	<1.00	<1.00	<1.00	<1.00
CHLOROMETHANE UG/L	34418 HA	<1.00	<1.00	<1.00	<1.00
1,1-DICHLOROETHANE UG/L	34496 HA	<1.00	<1.00	<1.00	<1.00
1,2-DICHLOROETHANE UG/L	34531 HA	<1.00	<1.00	<1.00	<1.00
1,1-DICHLOROETHYLENE UG/L	34501 HA	<1.00	<1.00	<1.00	<1.00
TRANS-1,2-DICHLORO ETHENE UG/L	34546 HA	<1.00	<1.00	<1.00	<1.00
METHYLENE CHLORIDE UG/L	34423 HA	<1.00	<1.00	<1.00	<1.00
1,1,2,2-TETRACHLORO ETHANE UG/L	34516 HA	<1.00	<1.00	<1.00	<1.00
TETRACHLOROETHENE UG/L	34475 HA	<1.00	<1.00	<1.00	<1.00
1,1,1-TRICHL'ETHANE UG/L	34506 HA	<1.00	<1.00	<1.00	<1.00
1,1,2-TRICHL'ETHANE UG/L	34511 HA	<1.00	<1.00	<1.00	<1.00
TRICHLOROETHENE UG/L	39180 HA	<1.00	<1.00	<1.00	<1.00
BENZENE UG/L	34030 PI	<1.00	25.0	<1.00	<1.00
ETHYLBENZENE UG/L	34371 PI	<1.00	<1.00	<1.00	<1.00
TOLUENE UG/L	34010 PI	<1.00	<1.00	<1.00	<1.00
XYLENES,TOTAL UG/L	81551 PI	<1.00	150	<1.00	<1.00
METHYL-T-BUT'ETHER UG/L	98676 PI	2.90	5.50	<1.00	5.42
VOA,TOTAL(BTEX,T) UG/L	97512 PI	<1.00	175	<1.00	<1.00

Figure 12-2
FINAL RESULTS OUTPUT FROM THE DATA PROGRAM

SOURCE: ESE.

ENVIRONMENTAL SCIENCE & ENGINEERING, INC.

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ESE ANALYTICAL SERVICES DELIVERABLE CHECKLIST

Project #_____ Project Name_____

Field Group(s)_____

			Comment
Department's "excepted" batch checklist(s) reviewed?	Y	N	
Corrective actions*/data flagging required?	Y	N	
If yes, performed?	Y	N	
Blank data (equipment, rinseate, field, trip) reviewed?	Y	N	NA
Corrective actions*/data flagging required?	Y	N	
If yes, performed?	Y	N	
Field dupe data reviewed?	Y	N	NA
Corrective actions*/data flagging required?	Y	N	
If yes, performed?	Y	N	
Data set reviewed against historical?	Y	N	NA
Data set reviewed for reasonableness?	Y	N	
If yes, by ____ self, or _____			
In general, were project QC requirements met?	Y	N	
If no, add comments below.			
QC deliverable prepared and reviewed?	Y	N	NA
Deliverables in conformance with requirements?	Y	N	

* Attach a copy of any corrective action

Comments:

Completed by_____ Reviewed by_____

Date_____ Date_____

Distribution:

WHITE - Information Services YELLOW - Laboratory Coordinator PINK - Div. Administration

Figure 12-3
DELIVERABLE CHECKLIST

SOURCE: ESE

ENVIRONMENTAL SCIENCE & ENGINEERING, INC.

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DOCUMENT CONTROL

PLEASE USE SEPARATE LINE FOR EACH BATCH CHECKED-OUT!

INITIALS	DATE/TIME OUT	DOCUMENT TYPE (e.g. Batch #, F.O. Files, etc.)	DOCUMENT DEPT #	DATE/TIME RETURN	INITIALS	✓

(CONTROL 06/92)

Figure 12-4
DOCUMENT CONTROL LOGSHEET

SOURCE: ESE

ENVIRONMENTAL SCIENCE & ENGINEERING, INC.

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13.0 CORRECTIVE ACTION

Corrective action is necessary when any measurement system fails to follow this LCQAP. Items that may need corrective action range from a minor problem of a field team member failing to sign a field form to a major problem of an analyst using an improper analytical method. For this reason, corrective action protocols must be flexible.

13.1 ANALYTICAL

In general, items needing corrective action fall into three "correction" categories: short-term, long-term, and QC; each item requires different action.

13.1.1 SHORT-TERM CORRECTIVE ACTIONS

These actions consist of minor and major problems that can be corrected immediately. Examples include failure to date or sign a standard form, incorrectly preserving sample, and errors in data entry. Corrective action is initiated by verbally calling attention to the problem followed by written notification.

13.1.2 LONG-TERM CORRECTIVE ACTIONS

The actions consist of minor and major problems that require a series of actions to resolve the problem. The actions to be taken are coordinated by the Project QA Coordinator or Laboratory QA/QC Manager, and a QA corrective action and routing form (Figure 13-1) is used to track the action. An example of this type of corrective action is as follows:

> Problem--A laboratory analyst fails to calibrate a pH meter prior to use.
> Corrective Action--The problem is identified by the person originating the corrective action, responsibility is assigned to an appropriate person (may be someone other than person failing to calibrate the instrument), re-training of the analysts in the use of the instrument is required, and the instrument is calibrated in prior to the next analysis. The Project QA Coordiantor or the QA/QC Coordinator audits this process to assure that it is completed in an expeditious manner.

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CORRECTIVE ACTION REQUEST AND ROUTING FORM

1. Identification of a problem: CA#_____

Originator: _____ Date: _____

Nature of Problem: _____

2. Determination of Required Action:

Responsibility Assigned to: _____ Due Date: _____

Recommended Action: _____

3. Implementation of Required Action:

Responsibility Assigned to: _____ Due Date: _____

4. Assuring Effectiveness of Action:

Responsibility Assigned to: _____ Due Date: _____

Procedure to Assure Effectiveness: _____

Corrective action status: _____ Acceptable _____ Unacceptable

Signature: _____ Date _____

Figure 13-1
QUALITY ASSURANCE CORRECTIVE ACTION REQUEST AND ROUTING FORM

SOURCE: ESE.

ENVIRONMENTAL SCIENCE & ENGINEERING, INC.

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13.1.3 QUALITY CONTROL CORRECTIVE ACTION

Consists of corrective action following a failure to meet QC criteria specified in this LCQAP and the analytical methods. Actions taken consist of two types: those resolved within each analytical department and those resolved outside the department. Examples outlining the differences between these two types of corrective action are as follows:

WITHIN DEPARTMENT ACTION

QC Failure	Department Action
Tuning results for GC/MS fail criteria in Methods 624 and 625	Analyst retunes instrument
Standard curve correlation coefficient is less than 0.995	Analyst investigates problem and reruns curve and samples
Sample response falls outside calibration curve	Analyst dilutes sample into range of curve

OUTSIDE DEPARTMENT ACTION

QC Failure	Department Action
Holding times are exceeded	Notify Project Manager, Laboratory Coordinator, and Project QA Coordinator; resampling may be necessary

The corrective action procedures that will be taken by the Gainesville Laboratory following a failure to meet QC criteria specified in this LCQAP and the analytical methods are summarized in Tables 13-1 through 13-6.

Corrective actions in the laboratory are documented and tracked using the Corrective Action Form (Figure 13-1).

Corrective actions may be initiated for each measurement system (individual disciplines) by subproject managers or other responsible individuals such as the Laboratory QA/QC Manager, Department Manager, or Division Manager. The Project QA Coordinator,

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Table 13-1. Summary of Corrective Action Procedures for Metals Analyzed by Graphite Furnace and Cold Vapor Atomic Absorption Spectroscopy

Quality Control	Acceptance Criteria	Corrective Action
Initial calibration verification standard (ICV)	+/- 10% of true value	Rerun standard, if still out of control, recalibrate instrument.
Calibration blank (ICB)	≤ two times DL (listed in Table 5-3)	Rerun the blank, if still out of control, reprocess and reanalyze the blank.
Calibration curve correlation coefficient	≥ 0.995	Rerun calibration standards, if still out of control, prepare new calibration standards and recalibrate the instrument or document why data are acceptable.
Calibration curve	Brackets all sample responses	Dilute and reanalyze within the calibration curve range or document why data are acceptable if reanalysis is not possible.
Continuing calibration verification standard (CCV)	+/- 20% of true value	Rerun standard, if still out of control, recalibrate instrument and reanalyze samples run since last acceptable CCV.
Method blank (MB)	≤ two times DL (listed in Table 5-3)	Determine the cause of the blank problem, redigest set, if necessary, or document why data are acceptable.

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Table 13-1. Summary of Corrective Action Procedures for Metals Analyzed by Graphite Furnace and Cold Vapor Atomic Absorption Spectroscopy (Continued, Page 2 of 2)

Quality Control	Acceptance Criteria	Corrective Action
Standard matrix spike (QC check standard)	See Table 5-2 for percent recovery control limits	Determine and correct problem, redigest and reanalyze samples, if necessary, or document why data are acceptable.
Sample matrix spike	See Table 5-2 for percent recovery control limits	If standard matrix spike analytes are within control limits, qualify the data. If not, determine and correct the problem, redigest and reanalyze samples, if necessary, or document why data are acceptable.
Sample matrix spike	See Table 5-2 for RPD control limits	If standard matrix spike analytes are within control limits, qualify the data. If not, determine and correct the problem, redigest and reanalyze samples, if necessary, or document why data are acceptable.

Note: DL = detection limit.
RPD = relative percent difference.

Source: ESE.

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Table 13-2. Summary of Corrective Action Procedures for Metals Analyzed by Inductively Coupled Plasma Emission Spectroscopy

Quality Control	Acceptance Criteria	Corrective Action
Initial calibration verification standard (ICV)	+/- 10% of true value	Rerun standard, if still out of control, recalibrate instrument.
Calibration blank (ICB)	≤ two times DL (listed in Table 5-2)	Rerun the blank, if still out of control, reprocess and reanalyze the blank.
Interference check standard (ICS)	+/- 20% of true value	Rerun standard, if still out of control, recalibrate instrument and reverify calibration.
Continuing calibration verification standard (CCV)	+/- 10% of true value	Rerun standard, if still out of control, recalibrate instrument and and reanalyze all samples run since last acceptable CCV or document why data are acceptable.
Method blank (MB)	≤ two times DL (listed in Table 5-2)	Determine the cause of the blank problem: redigest samples if necessary or document why data are acceptable.

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Table 13-2. Summary of Corrective Action Procedures for Metals Analyzed by Inductively Coupled Plasma Emission Spectroscopy (Continued, Page 2 of 2)

Quality Control	Acceptance Criteria	Corrective Action
Standard matrix spike (QC check standard)	See Table 5-2 for percent recovery control limits	Determine and correct problem, redigest and reanalyze samples, if necessary, or document why data are acceptable.
Sample matrix spike	See Table 5-2 for percent recovery control limits	If standard matrix analytes are within control limits, qualify the data. If not, determine and correct problem, reanalyze samples, if necessary, or document why data are acceptable.
Sample matrix spike duplicate	See Table 5-2 for RPD control limits	If standard matrix analytes are within control limits, qualify the data. If not, determine and correct the problem, reanalyze the samples, if necessary, or document why data are acceptable.

Note: DL = detection limit.
RPD = relative percent difference.

Source: ESE.

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Table 13-3. Summary of Corrective Action Procedures for Inorganics, Oil and Grease, Petroleum Hydrocarbons, and TOX

Quality Control	Acceptance Criteria	Corrective Action
Calibration curve coefficient	$\geq$ 0.995	Rerun calibration correlation standards if still out of control prepare new calibration standards and recalibrate the instrument, or document why data are acceptable.
Calibration curve	Brackets all sample responses	Dilute and reanalyze samples within the calibration curve range, or document why data are acceptable.
Calibration blank	$\leq$ two times the DL (listed in Table 5-3)	out of control, reprocess and reanalyze the blank.
Continuing calibration verification standard (CCV)	+/- 20% of true value	Rerun standard, if still out of control, recalibrate instrument and reanalyze samples run since last acceptable CCV or document why data are acceptable.
Method blank (MB)	$\leq$ two times the DL (listed in Table 5-3)	Determine the cause of the blank problem, reanalyze samples, if necessary, or document why data are acceptable.
Sample replicate (RP)*	See Table 5-2 for RPD	Determine and correct control limits problem, reanalyze sample, if necessary, or document why data are acceptable.

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Table 13-3. Summary of Corrective Action Procedures for Inorganics, Oil and Grease, Petroleum Hydrocarbons, and TOX (Continued, Page 2 of 2)

Quality Control	Acceptance Criteria	Corrective Action
Standard matrix spike (QC check standard)	See Table 5-2 for percent recovery control limits	Determine and correct problem, reanalyze samples if necessary or document why data are acceptable.
Sample matrix spike	See Table 5-2 for percent recovery control limits	If standard matrix analytes are within control limits, qualify the data. If not, determine and correct the problem, reanalyze samples, if necessary, or document why data are acceptable.
Sample matrix spike duplicate	See Table 5-2 for RPD control limits	If standard matrix analytes are within control limits, qualify the data. If not, determine and correct the problem, reanalyze the samples, if necessary, or document why the data are acceptable.

Note: DL = detection limit.
RPD = replicate percent difference.

*Sample replicate is only required for residues, pH, specific conductivity, and turbidity analyses.

Source: ESE.

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Table 13-4. Summary of Corrective Action Procedures for Radionuclides

Quality Control	Acceptance Criteria	Corrective Action
Background check	See Section 9.4.12	Check and clean the instrument and repeat the background check.
Performance check standard	See Section 9.4.12	Check the instrument and recount the standard, if still out of control, recalibrate the instrument and recount the standard or document why data are acceptable.
Method blank	≤ two times the RL (listed in Table 5-3)	Determine the cause of the blank problem, reanalyze samples, if necessary, or document why data are acceptable.
Sample replicate (RP)	See Table 5-2 for RPD control limits	Determine and correct the problem, reanalyze sample, if necessary, or document why data are acceptable.
Standard matrix spike (QC check standard)	See Table 5-2 for percent recovery control limits	Determine and correct the problem, reanalyze standard samples, if necessary, or document why data are acceptable.
Sample matrix spike	See Table 5-2 for percent recovery control limits	Determine and correct the problem, reanalyze samples, if necessary, or document why data are acceptable.

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Table 13-4. Summary of Corrective Action Procedures for Radionuclides

Quality Control	Acceptance Criteria	Corrective Action
Sample matrix spike duplicate	See Table 5-2 for RPD control limits	Determine and correct the problem, reanalyze samples, if necessary, or document why data are acceptable.

Note: RL = reporting limit
RPD = replicate percent difference

Source: ESE.

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Table 13-5. Summary of Corrective Action Procedures for Organics Analyzed by Gas Chromatography and High Pressure Liquid Chromatography

Quality Control	Acceptance Criteria	Corrective Action
Calibration curve correlation coefficient	≥ 0.995	Rerun calibration standards, if still out of control, prepare new calibration standards and recalibrate the instrument, or document why the data are acceptable.
Calibration curve	Brackets all sample responses	Dilute and reanalyze samples within the calibration curve range, or document why data are acceptable.
Continuing calibration standard (CCS)	+/- 15% of standard initial response for GC (except for NPD which is +/-25%) and +/- 10% of standard initial response for HPLC	Rerun standard, if still out of control, recalibrate instrument and reanalyze samples when last CCS is acceptable, or document why data are acceptable.
Method blank (MB)	< than two times DL for nonvolatile organics (listed in Tables 5-9 to 5-13, 5-16 to 5-35, and 5-40 to 5-61)	Determine and correct cause of the blank problem, reanalyze the samples, if necessary, or document why data are acceptable.
Method blank (MB)	No greater than five times DL (listed in Tables 5-5 and 5-7) for methylene chloride, acetone, toluene, and xylene organics. All other analytes must be ≤ two times DL (listed in Tables 5-5 and 5-7)	Reanalyze another MB. If second MB exceeds criteria, clean and recalibrate analytical system or document why data are acceptable.

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Table 13-5. Summary of Corrective Action Procedures for Organics Analyzed by Gas Chromatography and High Pressure Liquid Chromatography (Continued, Page 2 of 3)

Quality Control	Acceptance Criteria	Corrective Action
Standard matrix spike (SP)	See Tables 5-4 to 5-13, 5-16 to 5-35, and 5-40 to 5-61 for percent recovery control limits	Determine and correct the problem, reanalyze samples if necessary, or document why data are acceptable.
Sample matrix spike	See Tables 5-4 to 5-13, 5-16 to 5-35, and 5-40 to 5-61 for percent recovery control limits	If standard matrix spike analytes are within control limits, qualify the data. If not, determine and correct the problem, reanalyze samples, if necessary, or document why data are acceptable.
Sample matrix spike duplicate	See Tables 5-4 to 5-13, 5-16 to 5-35, and 5-40 to 5-61 for RPD control limits	If standard matrix analytes are within control limits, qualify the data. If not, determine and correct the problem, reanalyze samples, if necessary, or document why data are acceptable.
Surrogates* (SUR)	See Tables 5-18, 5-20, and 5-28 for percent recovery control limits	If surrogates in the MB or SP are within control limits, quality data. If not, reanalyze samples with surrogates outside criteria or document why data are acceptable.

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Table 13-5. Summary of Corrective Action Procedures for Organics Analyzed by Gas Chromatography and High Pressure Liquid Chromatography (Continued. Page 3 of 3)

Note: DL = detection limit.
GC = gas chromatography.
HPLC = high pressure liquid chromatography.
NPD = nitrogen-phosphorus detector.
RPD = relative percent difference.

*Surrogate/surrogates will only be spiked in samples if specified by the method.

Source: ESE.

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Table 13-6. Summary of Corrective Action Procedures for Organics by Gas Chromatography/Mass Spectrometry

Quality Control	Acceptance Criteria	Corrective Action
DFTPP or BFB instrument tuning	See Table 8-1 for tuning criteria	Retune instrument until within criteria.
Initial calibration standards	Percent RSD of RF of the calibration check compounds (CCC) are ≤ 30 percent (≤35 percent for Method 625)	Rerun calibration standards, if still out of criteria, prepare new calibration standards and rerun standards.
One-point daily calibration	RFs of CCCs are ≤25 percent (≤20 percent for Method 625) from average RFs in the initial calibration	Rerun standard, if still out of control, rerun calibration curve, or document why data are acceptable.
Method blank (MB)	< two times the DL (listed in Table 5-39) for semivolatile organics	Evaluate the impact of the presence of any target analytes in the method blank, the presence of low concentrations of phthalate may be acceptable. Reextract and reanalyze samples if presence of target analytes are unacceptable or document why data are acceptable. Background substraction may be applied.

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Table 13-6. Summary of Corrective Action Procedures for Organics by Gas Chromatography/Mass Spectrometry (Continued, Page 2 of 3)

Quality Control	Acceptance Criteria	Corrective Action
Method blank (MB)	No greater than 5 times the DL (listed in Tables 5-15 and 5-37) for methylene chloride, acetone, toluene, and xylene for volatile organics. All other analytes must be ≤ two times DL (listed in Tables 5-15 and 5-37)	Reanalyze another MB. If second MB exceeds criteria, clean and recalibrate the analytical system or document why data are acceptable.
Surrogate (SUR)	See Tables 5-14, 5-36, and 5-38 for percent recovery control limits	If surrogates in the MB or SP are within limits, qualify the data. If not, reanalyze samples with surrogates outside criteria or document why data are acceptable.
Standard matrix spike (SP)	See Tables 5-14, 5-36, and 5-38 for percent recovery control limits	If surrogates in the MB are within control limits, qualify the data. If surrogates in the MB are not within control limits, determine and correct the problem, reextract and reanalyze the sample, if necessary or document why data are acceptable.

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Table 13-6. Summary of Corrective Action Procedures for Organics by Gas Chromatography/Mass Spectrometry (Continued. Page 3 of 3)

Quality Control	Acceptance Criteria	Corrective Action
Sample matrix spike	See Tables 5-14, 5-36, and 5-38 for percent recovery control limits	If standard matrix spike compounds are within criteria, qualify the data. If not, check surrogates in the MB or SP, if within criteria, qualify the data. If both QCs are outside criteria, determine and correct the problem, reanalyze the samples or document why the data are acceptable.
Sample matrix spike duplicate	See Tables 5-14, 5-36, and 5-38 for RPD control limits	If standard matrix spike compounds are within criteria, qualify the data. If not, check surrogates in the MB or SP, if within criteria, qualify the data. If both QCs are outside criteria, determine and correct the problem, reanalyze the samples if necessary or document why data are acceptable.

Note: DL = detection limit.
RPD = relative percent difference.

Source: ESE.

Laboratory QA/QC Manager, Laboratory Department Manager, or Laboratory Director will be responsible for approving the corrective action.

13.2 EXTERNAL SOURCES

Corrective action may also be initiated from external sources. This may include performance sample results, split samples, audits (onsite or field by EPA, HRS, FDER, USATHAMA, HAZWRAP, NEESA, etc.), and data validation/review. Corrective actions recommended by agencies such as EPA, DER, etc. are prioritized, promptly acted on, and overseen by the Project QA Coordinator or Laboratory QA/QC Manager. Actions taken to resolve the problem will be documented and kept by the Project QA Coordinator or Laboratory QA/QC Manager.

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14.0 PERFORMANCE AND SYSTEM AUDITS AND PERSONNEL TRAINING

14.1 INTRODUCTION

Two types of audit procedures will be used to assess and document performance of laboratory staff: system audits and performance audits. These are performed at frequent intervals by the Laboratory QA/QC Coordinator and QA Coordinator. These audits form one of the bases for corrective action requirements and constitute a permanent record of the conformance of measurement systems to QA requirements.

14.2 SYSTEM AUDITS

System audits are inspections of training status, records, QC data, calibrations, and conformance to SOPs without the analysis of check samples. System audits are performed quarterly.

The system audit protocol for the laboratory is summarized as follows:
The QA Coordinator and Laboratory QA/QC Manager or designee will perform the laboratory system audit using the checklist in Figures 14-1 through 14-4. The documents to be reviewed are:

a. Parameter and/or laboratory notebooks;
b. Instrument logbooks;
c. Sample log-in, dispensing, and labeling for analysis;
d. QC criteria update for spike recoveries; and
e. Verify that deficiencies in the last audit were corrected.

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Department No._____ Room No._____

Sample Storage Areas

ITEM	YES	NO	NA
1. Is the check-out sheet being used properly?			
2. Is an S.O.P. for sample receipt, storage, and tracking available?			
3. Are the sample tracking forms completed?			
4. Is the area secured?			
5a. Is the temperature log current?			
5b. Is appropriate corrective action taken for any out-of-control readings?			
6. Are the samples properly labeled?			

Comments: _____

Figure 14-1
AUDIT CHECKLIST FOR SAMPLE STORAGE AREAS

SOURCE: ESE.

ENVIRONMENTAL SCIENCE & ENGINEERING, INC.

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Department No._____ Room No._____

Sample Receiving

ITEM	YES	NO	NA
1. Is an S.O.P. for receipt, log-in, and transfer to storage areas available?			
2. Are the tracking forms complete?			

Comments: _____

Department No._____ Room No._____

Glassware Washroom

ITEM	YES	NO	NA
1. Is the area clean?			
2. Are S.O.P.'s available?			
3. Is clean glassware stored so as to avoid contamination?			

Comments: _____

Figure 14-2
AUDIT CHECKLIST FOR SAMPLE RECEIVING AND GLASSWARE WASHROOM AREAS

SOURCE: ESE.

ENVIRONMENTAL SCIENCE & ENGINEERING, INC.

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Department No._____ Room No.___

Sample Preparation Areas

ITEM	YES	NO	NA
1. Are refrigerator/freezer temperature logs maintained daily?			
2. Are appropriate corrective actions taken for any out-of-control readings?			
3. Are the balance calibration logs maintained daily?			
4. Is glassware stored so as to avoid contamination?			
5. Are samples and reagents stored so as to avoid contamination?			
6. Are the work spaces clean and organized to avoid cross-contamination and sample-handling errors?			
7. Are appropriate S.O.P.'s available?			
8. Are instrument run logs maintained? (Org. ext. lab)			
9. Are instrument maintenance logs maintained?			
10. Are the standard preparation logs completely filled out, including preparer and reviewer signatures?			
11. Are the sample preparation logs completely filled out, including preparer and reviewer signatures?			
12. Do all log books have control numbers?			
13. Are documentation corrections made properly? (A single line through the error, the date the correction was made, the correctors initials, and a short explanation or correction code if necessary.)			
14. Are reagents labeled with the date received, date opened, and expiration date?			
15. Are extracts labeled properly?			
16. Are properly labeled waste containers available?			

Comments: _____

Figure 14-3
AUDIT CHECKLIST FOR SAMPLE PREPARATION AREAS

SOURCE: ESE.

ENVIRONMENTAL SCIENCE & ENGINEERING, INC.

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Department No._____ Room No._

Sample Analysis Areas

ITEM	YES	NO	NA
1. Are refrigerator/freezer temperature logs maintained daily?			
2. Are appropriate corrective actions taken for any out-of-control readings?			
3. Are the balance calibration logs maintained daily?			
4. Is glassware stored so as to avoid contamination?			
5. Are samples and standards stored so as to avoid contamination?			
6. Are the work spaces clean and organized to avoid cross-contamination and sample-handling errors?			
7. Are appropriate S.O.P.'s available?			
8. Are instrument run logs maintained?			
9. Are instrument maintenance logs maintained?			
10. Are the standard preparation logs completely filled out, including preparer and reviewer signatures?			
11. Are the sample preparation logs completely filled out, including preparer and reviewer signatures?			
12. Do all log books have control numbers?			
13. Are documentation corrections made properly? (A single line through the error, the date the correction was made, the correctors initials, and a short explanation or correction code if necessary.)			
14. Are reagents labeled with the date received, date date opened, and expiration date?			
15. Are properly labeled solvent waste containers available?			

Comments: _____

Figure 14-4
AUDIT CHECKLIST FOR SAMPLE ANALYSIS AREAS

SOURCE: ESE.

ENVIRONMENTAL SCIENCE & ENGINEERING, INC.

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In addition, the Laboratory QA/QC Coordinator or QA Coordinator may monitor analyses randomly to assure adherence to approved analytical methods.

3. Final Reports--The Project QA Coordinator may review all final reports and deliverables before they are sent to the client.

The Gainesville Laboratory is externally audited regularly by the following agencies:

1. State of Florida Department of Health and Rehabilitative Services.
2. State of New Jersey Department of Environmental Protection and Energy.
3. State of California Department of Health.
4. State of Utah Department of Health.
5. U.S. Army Corps of Engineers.
6. American Industrial Hygiene Association, and
7. Army Environmental Center (AEC) (formerly U.S. Army Toxic and Hazardous Materials Agency).

14.3 PERFORMANCE AUDITS

The results of interlaboratory studies may be evaluated by the Project QA Coordiantor as part of the performance audits. This evaluation is performed at least quarterly. ESE is participating in the following proficiency programs:

1. National Institute of Occupational Safety and Health (NIOSH) through its Proficiency Analytical Testing Program (PAT).
2. EPA Water Pollution and Water Supply proficiency programs.
3. EPA Radiochemistry Intercomparison Study and Blind Performance Samples.
4. State of New York through its Environmental Laboratory Approval Program (ELAP) for public drinking water and environmental samples categories.
5. State of California Department of Health.
6. U.S. Army Corps of Engineers.

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7. U.S. Department of Energy's Environmental Measurements Laboratory Quality Assessment Program, and
8. U.S. Department Of Energy's Hazardous Waste Remedial Actions Program (HAZWRAP).

The following licenses, accreditations, certifications and validations are held by the Gainesville Laboratory:

1. American Industrial Hygiene Association (AIHA).
2. State of Florida Department of Health and Rehabilitative Services for environmental and drinking water analyses.
3. New Jersey Department of Environmental Protection.
4. South Carolina Department of Health and Environmental Control.
5. State of Florida Department of Health and Rehabilitative Services for Radiochemistry.
6. State of California Department of Health Services for hazardous waste testing analyses.
7. State of Tennessee Department of Health and Environment for drinking water and underground storage testing analyses.
8. State of Utah Department of Health.
9. U.S. Army Environmental Center.
10. U.S. Army Corps of Engineers.
11. U.S. Navy, and
12. U.S. Department of Energy's HAZWRAP.

Peer review of all deliverable reports and data will be performed by technically qualified individuals from each major discipline represented in the deliverable. Figure 14-5 is a sample Deliverable Review Sheet.

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ESE	DELIVERABLE REVIEW SHEET

SHORT TITLE: _____ CLIENT: _____

PROPOSAL/PROJECT NUMBER: _____ DATE/TIME TO LEAVE ESE: _____

PROPOSAL/PROJECT MANAGER: _____ CLIENT DUE DATE: _____

AUTHOR(S): _____ DOCUMENT COORDINATOR: _____

REVIEW CHECKLIST REVIEWER SHOULD PLACE CHECK UNDER APPROPRIATE REVIEW CATEGORY D—DRAFT F—FINAL		REQUIRED REVIEW								OPTIONAL REVIEW BY AUTHOR OR OTHER QUALIFIED INDIVIDUAL							
		①		②		③		④									
REVIEWER'S INITIALS	DOCUMENT/SECTION	D	F	D	F	D	F	D	F	D	F	D	F	D	F	D	F
	Document:																
	SECTIONS:																

APPROVALS: _____ _____ _____ [illegible]

AUDITED BY: _____ [illegible]

REMARKS _____

① Required review by at least one reviewer other than author in their discipline.
② Required F & A review for proposals
③ Required check by laboratory coordinator or other individual for laboratory data reports.

ORIGINAL TO PROJECT MANAGER—COPY TO [illegible] FORM [illegible]

Figure 14-5
DELIVERABLE REVIEW SHEET

SOURCE: ESE.

ENVIRONMENTAL SCIENCE & ENGINEERING, INC.

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14.4 PERSONNEL TRAINING

The Gainesville Laboratory personnel are trained on health and safety, QA/QC procedures, analytical methods, and the laboratory data management system as specified in the laboratory's SOP on personnel training (SOP-AS3210-004). New personnel are trained prior to performing any actual laboratory work. Laboratory personnel are also required to attend the health and safety and laboratory QA/QC procedures refreshercourses that will be offered yearly. The training that each laboratory personnel had attended are documented on the personnel's training records that are maintained by the Laboratory QA/QC Coordinator.

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15.0 QUALITY ASSURANCE REPORTS

Activities and actions to be reported will include:

1. Results of ongoing performance, systems and analytical method audits, and

2. Data quality review and significant QA/QC problems with proposed corrective action procedures.

The Laboratory QA/QC Manager reports the results of these activities to the Gainesville Laboratory Management. The QA/QC report is done on a quarterly basis or immediately upon discovery of a problem requiring corrective action.

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Appendix B

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APPENDIX B

SITE SAFETY AND HEALTH PLAN

LANDFILL CHARACTERIZATION, SITE H-06-L
HANFORD NORTH SLOPE, WASHINGTON

April 1994

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MISCELLANEOUS ARCHITECT ENGINEER SERVICES FOR HAZARDOUS, TOXIC, AND RADIOLOGICAL WASTE (HTRW) PROJECTS FOR U.S. ARMY CORPS OF ENGINEERS WALLA WALLA DISTRICT

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SITE SAFETY AND HEALTH PLAN

LANDFILL CHARACTERIZATION AND REMEDIATION
SITE H-06-L
HANFORD NORTH SLOPE, WASHINGTON

CONTRACT NO. DACW68-94-D-001

Approved by: _____ Date: 4/7/94

Charles J. Myers, C.I.H.
Health and Safety Manager

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Site Safety and Health Plan Review

_____ Date _____

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LIST OF ABBREVIATIONS AND ACRONYMS

ACGIH	-	American Conference of Governmental Industrial Hygienists
ANSI	-	American National Standards Institute
bkgd	-	Background
CERCLA	-	Comprehensive Environmental, Response, Compensation, and Liability Act
CGI	-	Combustible gas indicator
CHSM	-	Corporate Health & Safety Manager
CIH	-	Certified Industrial Hygienist
CPR	-	Cardiopulmonary resuscitation
CQAR	-	Contractor Quality Assurance Representative
CQCR	-	Contractor Quality Control Representative
CRZ	-	Contamination reduction zone
DOE	-	Department of Energy
EPA	-	United States Environmental Protection Agency
FAA	-	First Aid Attendant
FID	-	Flame-ionization detector
HEPA	-	High efficiency particulate air
HP	-	Health Physicist
LEL	-	Lower explosive limit
MSA	-	Mining Safety Act
MSDS	-	Material Safety Data Sheet
NIOSH	-	National Institute of Occupational Safety and Health
OSHA	-	Occupational Safety and Health Administration
OVA	-	Organic vapor analyzer
OVM	-	Organic vapor monitor
PEL	-	Permissible exposure limit
PID	-	Photoionization detector
PPE	-	Personal protective equipment
ppm	-	Parts per million

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RFNA	-	Red-Fuming Nitric Acid
SOPs	-	Standard operating procedures
SSHP	-	Site Safety and Health Plan
SSHO	-	Site Safety and Health Officer
TOV	-	Total Organic Vapors
TWA	-	Time-weighted average
USACE	-	U.S. Army Corps of Engineers
UV	-	Ultraviolet
VOCs	-	Volatile organic compounds
WAC	-	Washington Administrative Code
WDOT	-	Washington Department of Transportation
WHC	-	Westinghouse Hanford Company
WISHA	-	Washington Industrial Safety and Health Administration

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1.0 INTRODUCTION

This Site Safety and Health Plan (SSHP) has been developed by CDM Federal Programs Corporation (CDM Federal) specifically for field investigation activities to be performed at the H-06-L Landfill site, located on the North Slope of the Hanford Reservation near Richland, Washington.

Site activities in conjunction with this project may pose unique safety and chemical exposure hazards. This SSHP addresses accident prevention, personal protection, and emergency response procedures. It establishes in detail the protocols necessary for protecting workers and on-site personnel, the public, and the environment from hazards associated with the following investigation tasks:

- Geophysical Surveys
- Excavation and Trenching
- Waste Segregation
- Soil/Debris Sampling

This SSHP has been prepared based on-site specific information collected during previous site investigations, and is written to comply with the CDM Federal Programs Corporation Corporate Health and Safety Program and U.S. Army Corps of Engineers (USACE) Safety and Health Requirements Manual (EM 385 1-1). This plan is applicable to all site visitors, contractor and sub-contractor personnel, and USACE personnel.

1.1 PROJECT DESCRIPTION

CDM Federal will provide manpower and equipment to investigate abandoned landfills and where necessary, provide services for the on-site disposition of investigation-derived waste including, but not limited to, "clean" soil, concrete, building materials and other miscellaneous debris. These materials will be disposed at designated work areas within the Hanford site managed by the U. S. Department of Energy (DOE), Richland Operations Office.

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The objectives of the work are twofold:

1) Conduct geophysical surveys to evaluate the presence of buried wastes beyond originally surveyed areas, and

2) Characterize wastes present in known and newly identified geophysical anomaly areas and sample and segregate potentially hazardous materials.

1.2 WORK SITE DESCRIPTION/HISTORY

The H-06-L Landfill site is located in an area known as the North Slope of the Hanford Reservation (Figure 1-1 and 1-2).

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The North Slope consists of approximately 140 square miles of land north of the Columbia River across from the active area of the Hanford Reservation. The North Slope was homesteaded from the late 1800's until the government took control of this area in the early 1940's. Prior to government control of the North Slope, homesteaders used the land primarily for grazing of sheep and cattle and growing of row corps and orchards. Wheat was grown on high ground away from the river. Grazing took place on land too arid or too distant from water for crops.

Additional land acquisitions took place in the 1950s for construction of the Nike Missile Air Defense System and anti-aircraft emplacements as well as to increase the buffer zone from the public lands and the production areas of the reservation. There were a total of seven anti-aircraft gun emplacements, and three Nike missile positions were located on the North Slope. The military sites were closed down in the early 1960s. Many of the military buildings were considered a potential hazard to the public and were torn down or decommissioned in the mid 1970's. Evidence remains of the existence of many of these buildings. The site has not had

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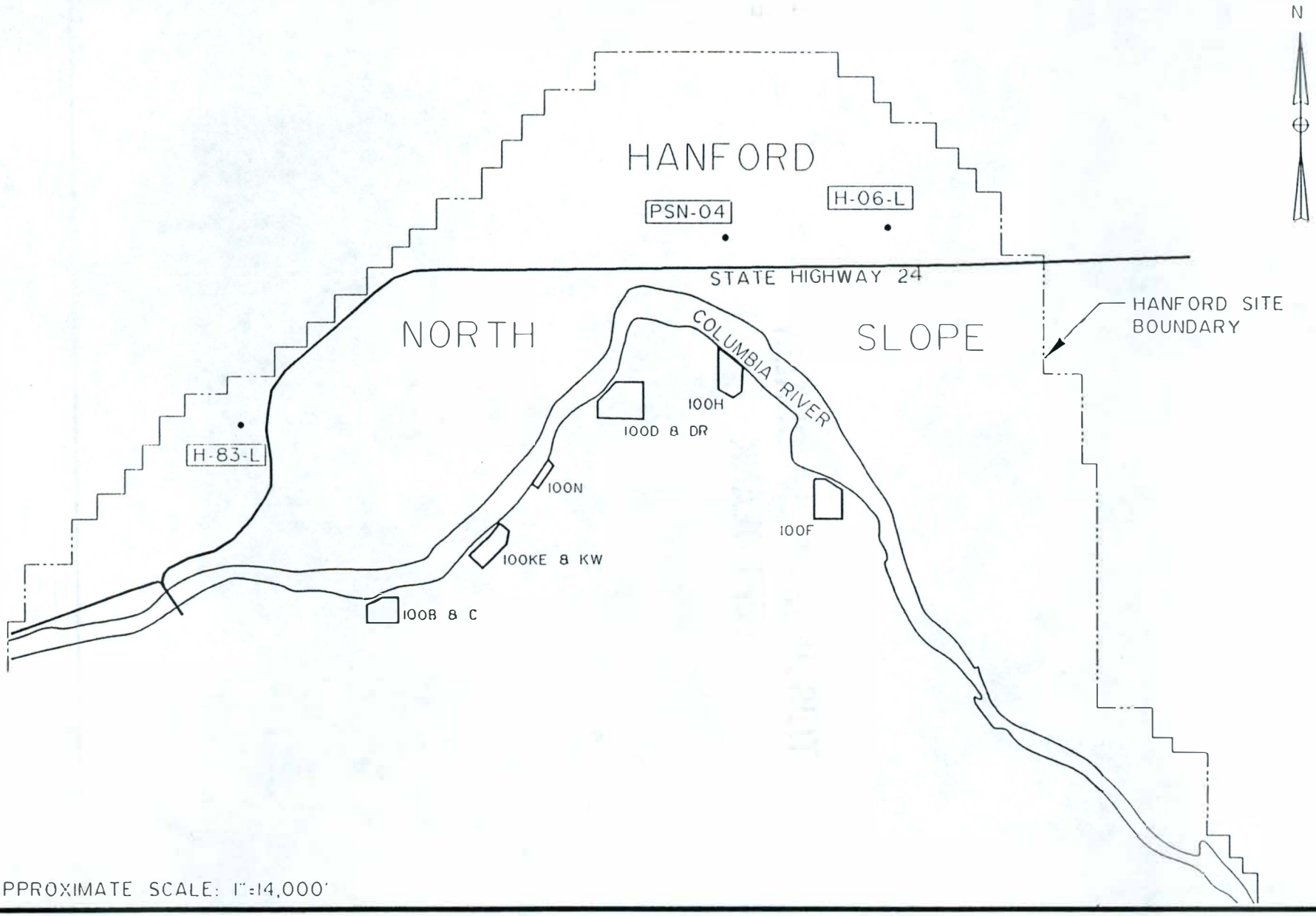

APPROXIMATE SCALE: 1"=14,000'

Site Location Map
Hanford North Slope, Washington

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

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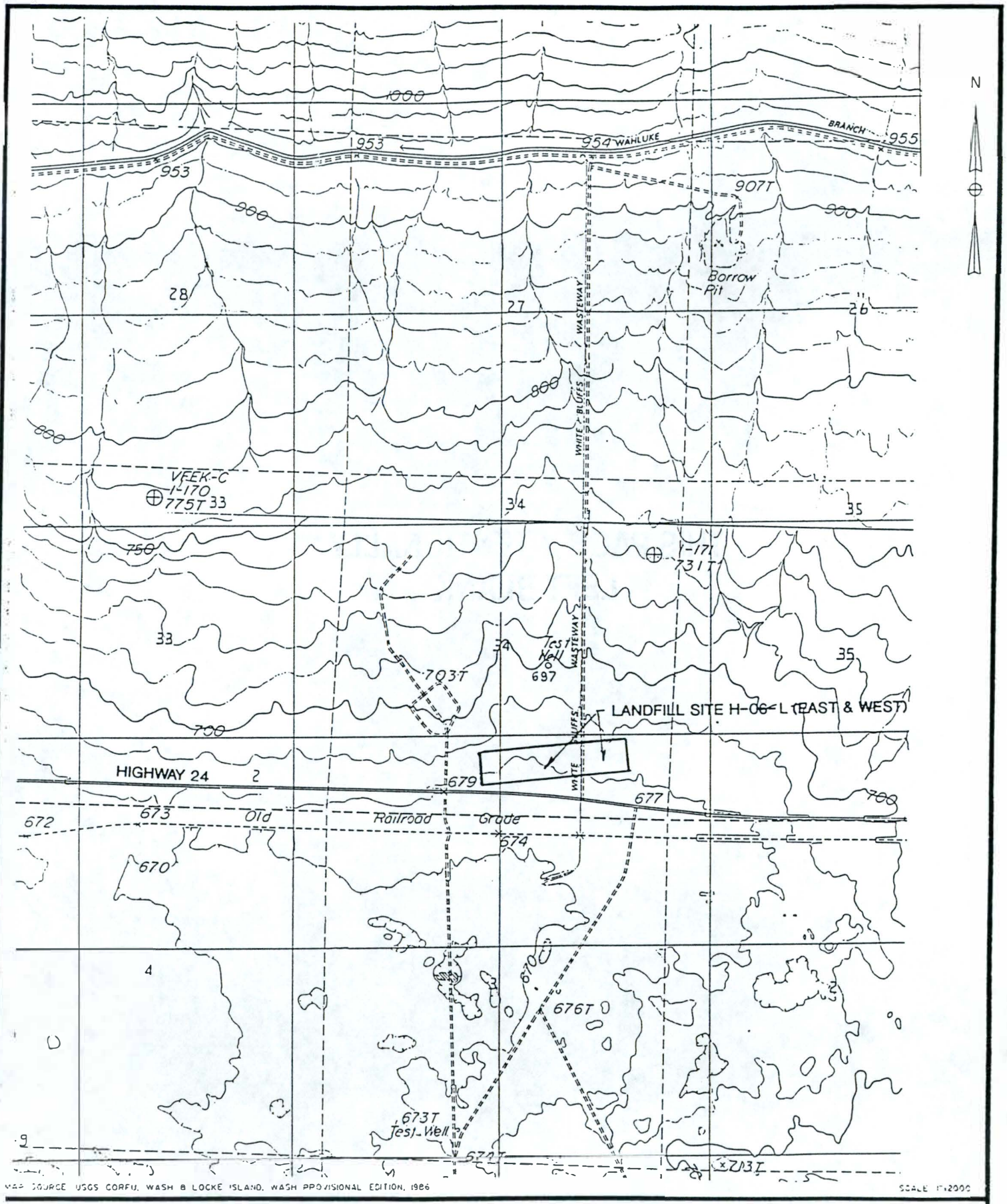

MAP SOURCE USGS CORFU, WASH & LOCKE ISLAND, WASH PROVISIONAL EDITION, 1986

SCALE 1"=2000'

LOCATION OF LANDFILL SITE
H-06-L (EAST AND WEST)

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

Figure No. 1-2

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any active military installations on it since this period; however, the site has been used for military training maneuvers.

There are 10 landfills (including H-06-L East and West) associated with the former military installations on the North Slope. The specific contents of the military landfills is unknown. It is probable, based on debris scattered on the surface, that domestic trash and demolition debris were disposed of at these sites. It is possible that the landfills associated with missile sites may contain traces of contributed small quantities of hazardous constituents as operational information indicates Jet fuel, inhibited red-fuming nitric acid (IRFNA), aniline, hydrazine, and trichloroethylene used in support of missile operations. Interviews with former military personnel assigned to the area indicate that these substances were used conservatively and were not normally available in large quantities. Limited vehicle maintenance activities may have contributed used motor oil to the landfills. Demolition wastes likely included asbestos-based materials such as transite.

With the recent change in mission at Hanford from plutonium production to environmental cleanup, attention has been given to releasing relatively clean tracks of land for other uses. Since 1975 the area has been permitted to the Washington Department of Wildlife and the U.S. Fish and Wildlife Service. Some areas have been open to the public. Certain areas included in the wildlife management area have been opened for cattle grazing to ranchers who obtain grazing agreements. Some areas are still currently being grazed. The eastern portion of the land also contains a wasteway used to rid local farms of runoff.

Westinghouse Hanford Company (WHC) conducted an investigation of the site in 1990. Thirty-nine sites associated with either military or homesteading activities were discovered as the result of this investigation [see the North Slope Investigation Report (WHC 1990)]. The North Slope Expedited Response Action Proposal (DOE/RL-93-47) also summarized information on these sites.

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The North Slope area is considered to be a relatively clean tract of land. The goal of this landfill characterization is to collect sufficient subsurface soil analytical data to determine the extent of the landfill trenches and waste types at the H-06-L site.

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2.0 SITE DESCRIPTION AND CONTAMINATION CHARACTERIZATION

The safety policy for this project is based upon guidance set forth by the U.S. Environmental Protection Agency (EPA) in "Guidance for Conducting Remedial Investigations and Feasibility Studies" (EPA, 1988). This guidance requires cognizant agencies and contractors to take every reasonable precaution in the performance of work to ensure that all activities will be conducted in an environmentally safe manner for the workers and the surrounding community. Additional health and safety requirements which should be incorporated into the SSHP as applicable can be found in the following references:

- 29 CFR 1910, Occupational Safety and Health Administration (OSHA) Safety and Health Standards (particularly 29 CFR 1910.120, Hazardous Waste Operations and Emergency Response).
- WAC 296-62, Washington Industrial Safety and Health Act (WISHA) General Occupational Health Standards.
- EM 385-1-1, U.S. Army Corps of Engineers, Safety and Health Requirements Manual, October 1992.

The project positions as they pertain to health and safety functions are described in the remainder of this section.

2.1 CERTIFIED INDUSTRIAL HYGIENIST

The project certified industrial hygienist (CIH) is:

Charles Myers, CIH
CDM Federal Programs Corporation
13135 Lee Jackson Memorial Highway, Suite 200
Fairfax, Virginia 22083
(703) 968-0900

Mr. Myers is certified as an Industrial Hygienist (Certificate #2675) by the American Board of Industrial Hygiene and certified in Hazardous Materials Management (#619) by the

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International Board of Hazardous Materials Management, and Hazard Control Management (#1539) by the International Board of Hazard Control Management. Mr. Myers has 16 years of experience as an industrial hygienist, including 10 years of experience related to hazardous and radiological waste site remediation. Mr. Myers serves as the Corporate Health and Safety Manager (CHSM) for CDM Federal.

The CIH has the following duties and responsibilities:

- Developing and maintaining this SSHP.
- Implementation, enforcement, and oversight of the SSHP.
- Conducting periodic site safety audits.
- Enforcing the SSHP requirements in subcontractor procurement efforts.
- Ensuring that employees are trained in site specific hazards.
- Supervising the activities of the Site Safety and Health Officer (SSHO) in performance of health and safety activities.
- Specifying proper personal protective equipment for each appropriate work zone and work task.
- Developing standard work site safety and health practices.
- Developing heat stress monitoring procedures for employees working in protective clothing or respirators.
- Developing additional health and safety procedures as necessary.

2.2 CONTRACTOR QUALITY CONTROL REPRESENTATIVE (CQCR) / SITE SAFETY AND HEALTH OFFICER (SSHO)

CDM Federal has appointed Paul Karas as CQCR/SSHO with responsibility to enforce the Safety & Health requirements contained in EM358-1-1 as they pertain to CDM Federal. Mr. Karas will be on-site to supervise the subsurface soil/debris sampling and to document activities associated with excavation and sampling.

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The SSHO reports directly to the CHSM relative to health and safety concerns involving this project. The SSHO has the following duties and responsibilities:

- On-site implementation and enforcement of the SSHP.
- Conducting site safety checks.
- Performing air monitoring in support of site activities.
- Enforcing the SSHP for subcontractor tasks.
- Ensuring employees assigned to the site have received necessary training.
- Conducting daily on-site "tail-gate" safety meetings.
- Enforcing the use of proper personal protective equipment (PPE) for each appropriate work zone and work task.
- Designating and enforcing the observance of support, contamination reduction and exclusion zones.
- Supervising the personnel and equipment log-in and log-out records.
- Enforcing the observance of standard work site safety and health practices as defined in this SSHP.
- Implementing heat stress monitoring procedures.
- Performing first aid and notifying appropriate authorities in emergencies.
- Keeping records and logs described in Section 12.0 of this SSHP.
- Performing additional tasks as necessary to ensure the health and safety of employees and subcontractors.

2.3 FIRST AID ATTENDANT

Two people trained in first aid/cardiopulmonary resuscitation (CPR) will be on-site at all times that a CDM Federal employee or a subcontractor performs work. In general, the SSHO, who is trained in first aid/CPR, will act as the first aid attendant (FAA).

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2.4 PERSONNEL ASSIGNED TO THIS PROJECT

The CDM Federal personnel listed below may be assigned to conduct the field work of this project. Their medical, respirator, training, and field certifications have been provided to the USACE separately.

Paul Karas	David Park	John Dwyer
Krista Lippoldt	Amare Astatke	Jim Moore

Minimum training and certifications for field staff are as follows:

- 40-Hour Hazardous Waste Operations Training in compliance with 29 CFR, 1910.120.
- 8-Hour refresher course within the past year (12 mo.)
- Current enrollment in a medical monitoring program designed to comply with the requirements of 29 CFR, 1910.120.
- Evidence of successful quantitative fit test for an air-purifying respirator, within the last year.
- Asbestos training is not a requirement for CDM Federal staff or sub-contractors. The USACE will provide an individual qualified in asbestos awareness and recognition.

Required certifications for all CDM Federal staff and subcontractors will be provided to the USACE prior to commencement of work and will be maintained on-site throughout the project. USACE will have field personnel available onsite to provide continuous oversight of all activities.

2.5 APPLICABLE REGULATIONS AND GUIDELINES

The SSHP and all work activities associated with this project are required to comply with the applicable provisions of:

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- U.S. Army Corps of Engineers, Safety and Health Requirements Manual EM 385-1-1, October 1992 (U.S. Government Printing Office, Washington, D.C.). Hereinafter referred to as EM 385-1-1.

- Federal Acquisition Regulations System, 48 CFR 52.236-13, Accident Prevention (U.S. Government Printing Office, Washington, D.C.).

- U.S. Environmental Protection Agency, Standard Operating Safety Guides, November 1984 (U.S. Government Printing Office, Washington, D.C.).

- U.S. Department of Labor, OSHA, General Industry Standards 29 CFR 1910, Especially 29 CFR 1910.120, OSHA Standard for Hazardous Waste Operations and Emergency Response. (U.S. Government Printing Office, Washington, D.C.). Hereinafter, OSHA General Industry Standards.

- U.S. Department of Labor, OSHA, Construction Standards 29 CFR 1926 (U.S. Government Printing Office, Washington, D.C.).

- NIOSH/OSHA/USCG/EPA, Occupational Health Guidance Manual for Hazardous Waste Site Activities U.S. Department of Health and Human Services, 1985 (U.S. Government Printing Office, Washington, D.C.).

- CDM Federal Programs Corporation Corporate Health and Safety Program, CDM Federal Programs Corporation, Fairfax, VA.

The applicable provisions are adopted by reference to work performed on this site.

2.6 CONTRACTOR QUALITY ASSURANCE REPRESENTATIVE (CQAR)

The CQAR is a USACE employee responsible for contractor oversight and enforcement of safety and health requirements.

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3.0 ACTIVITY HAZARD ANALYSIS (EM 385-1-1 01.A.09)

Prior to beginning each major phase of work, the contractor performing that work shall prepare an Activity Hazards Analysis (AHA). (A major phase of work is defined as an operation involving a type of work presenting hazards not experienced in previous operations or where a new subcontractor or work crew is to perform).

- The analysis will define the activity being performed and identify the sequence of work, the specific hazards anticipated, and the control measures to be implemented to eliminate or reduce each hazard to an acceptable level.
- Work will not proceed on that phase until the activity hazard analysis has been accepted by the designated authority and discussed with all engaged in the activity, including the contractor, subcontractor(s), and government on-site representatives.

This section presents a general assessment of potential hazards associated with the H-06-L Landfill Characterization and Remediation Project. An AHA, will be prepared in accordance with EM 385-1-1 prior to commencement of work.

Potential hazards associated with activities planned for the landfill site characterization and remediation are identified. Hazards associated with these activities can be grouped into three categories: physical, safety, and chemical hazards. Based on a review of available information, the USACE identified contaminants of concern that are possibly accessible for human receptor exposure. Material safety data sheets or information sheets on some of the suspected contaminants as well as chemicals which will be used during the investigation (e.g., sample preservatives) will be maintained on-site.

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3.1 PHYSICAL HAZARDS

Potential physical hazards identified for the field investigation include noise exposure, heat stress, cold stress, and venomous reptiles and insects. Based on-site history, exposure to ionizing radiation is not anticipated.

3.1.1 NOISE

The primary noise source identified is the backhoe and dozer equipment. All employees and visitors who are exposed to noise levels exceeding 85 decibels for any duration will wear hearing protection. See EM 385-1-1 Section 05.C.

3.1.2 HEAT STRESS

Ambient temperatures at the site are not anticipated to be extremely high because the work is scheduled for the spring season. However, moderate temperatures combined with personal protective equipment (PPE) requirements could potentially result in exposure to heat stress conditions. The combination of heat generation from radiant heat, body heat, and the loss or restriction of the body's cooling mechanism (e.g., evaporative cooling) can put one at risk for heat stress. Signs and symptoms of heat stress are listed in Table 3-1.

Replenishment of bodily fluids, work/rest regiment, and training specifically on heat stress conditions shall be provided for workers when ambient temperatures exceed 70°F. Table 3-2 depicts work/rest requirements for site activities. Workers will generally not be monitored for heat stress conditions if normal work clothes are worn and when the temperature does not exceed 70°F. Workers will take mandatory breaks if their heart rate exceeds 110 beats per minute and their oral temperature exceeds 99.6°F. Drinking water will be provided on-site for workers. Finally, it is important to protect skin and eyes from excess exposure to ultraviolet (UV) radiation. Safety glasses with UV protection, sunscreen, and hats with visors will be required for field personnel, as necessary.

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Table 3-1
Signs and Symptoms of Heat Stress

Description
▸ **Heat rash** may result from continuous exposure to heat or humid air.
▸ **Heat cramps** are caused by heavy sweating with inadequate electrolyte replacement. Signs and symptoms include: – Muscle spasms – Pain in the hands, feet, and abdomen
▸ **Heat exhaustion** occurs from increased stress on various body organs including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms include: – Pale, cool, moist skin – Heavy sweating – Dizziness – Nausea – Fainting
▸ **Heat stroke** is the most serious form of heat stress. Temperature regulation fails and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury and death occur. Competent medical help must be obtained. Signs and symptoms are: – Red, hot, usually dry skin – Lack of or reduced perspiration – Nausea – Dizziness and confusion – Strong, rapid pulse – Coma

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Table 3-2*

Suggested Frequency of Rest for Fit and Acclimatized Workers[a]

Adjusted Temperature[b]	Impervious Clothing	Regular Work Clothes
>90°F	After 15 minutes	After 30 minutes
87.5 - 90°F	After 30 minutes	After 45 minutes
82.5 - 87.5°F	After 60 minutes	After 75 minutes
77.5 - 82.5°F	After 90 minutes	After 90 minutes
72.5 - 77.5°F	After 120 minutes	After 120 minutes

(a) For work levels of 250 kilocalories per hour (digging ditches, shoveling, etc.)

(b) Calculate for adjusted air temperatures (ta). [°F = ta°F + (13 x % sunshine)] where percent is expressed as a decimal.

* Taken from NIOSH/OSHA/USCG/EPA, Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, U.S. Department of Health and Human Services, 1985.

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3.1.3 COLD STRESS

Extremely low ambient temperatures at the site are also not anticipated because the work is to be performed during the spring season. However, it is possible that cold fronts, high winds, or early morning/late evening work can subject personnel to cold stress. Should ambient temperatures drop below 32°F or wind speeds exceed 20 miles per hour, the CQCR/SSHO shall consult with the CHSM. Provisions for additional body protection are required if work is performed in work below 4°C or 39.2°F. Workers should wear cold protective clothing appropriate for the level of cold and physical activity.

Hypothermia is the lowering of the body's core temperature when the heat loss to the environment exceeds heat production in the body. This condition can develop in cool (35° to 50°F), wet, and windy conditions where a person does not recognize the symptoms. Signs and symptoms of hypothermia are presented in Table 3-3.

3.1.4 FAUNA AND FAUNA BY-PRODUCT HAZARDS

Rubbish and debris often provide good habitat and cover for many of the hazardous fauna found on-site. Venomous reptiles and insects are prevalent on the North Slope. Examples of hazardous fauna or their by-products include:

- Black Widow Spider (Note: all species do not always have a characteristic red, hour-glass shape on the underside. Assume all spiders with a black, shiny, bulbous abdomen as being in the black widow genus family.)
- Hobo Spider (Cone-shaped web)
- Ticks (Transmission of lyme diseases, rocky mountain spotted fever, etc.)
- Rodents (Carriers of Hanta virus, bubonic plague, rabies, lice, etc.)
- Rattlesnakes (Western and Rocky Mountain types) Note: not all rattlesnakes may give a warning of their whereabouts.

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Table 3-3
Signs and Symptoms of Hypothermia

Body Core Temperature	Symptoms Felt by Victim	Symptoms Observed by Others
Normal body temp.: 98.6°F		
99-96°F	Inability to perform complex tasks, fatigue, uncontrollable shivering	Decreasing coordination, slowing of activity, weakness, dizziness
96-91°F	Violent shivering, difficulty speaking, sluggish thinking, feeling of deep cold, numbness	Difficulty with speech, sluggish reactions, stumbling, tense muscles, loss of attention
90-86°F	Shivering decreases; muscles rigid; poor muscle coordination; jerky, erratic motions; dull comprehension; amnesia; loss of will power; mental exhaustion	Poor judgement; hallucinations; faltering, jerky motions; bluish skin
85-81°F	Stupor, loss of contact with environment, muscular rigidity, slower pulse and respiration, blue skin, intense fatigue, great desire for rest	Stupor, blue skin, tiredness, lack of will power, pupil dilation
80-78°F	Great weakness, unconsciousness	Unconsciousness, muscular failure, decreased heart and respiratory rate
Below 78°F	Unconsciousness	Whitish froth from mouth, blue skin and fingernails, eyelids grey-blue, labored breathing, cardiac fibrillation, death

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- Night Snake (Mildly poisonous)
- Bees, Wasps, Yellow jackets (Workers allergic to bee stings shall carry the appropriate antidote with them or keep it in close proximity while in the field.)
- Mosquitoes (Encephalitis)
- Pigeon feces (Carriers of over 20 pathogen organisms, including ticks, mites, lice, fleas, chiggers, bedbugs. Common disease transmission includes: psittacosis, Q fever, paratyphoid, meningitis, New Castle disease, etc.)
- Scorpions (venom of species of this area is equivalent to a bee sting, only mildly toxic.)

Field personnel will not pick up, tease, or play with snakes or any other wildlife in the area.

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3.2 SAFETY HAZARDS

Potential safety hazards identified for the remedial investigation include slips, trips, falls, electricity, soft or hummocky ground, and fire.

3.2.1 SLIPS, TRIPS, AND FALLS

Slips, trips, and falls are of concern during the current scope of work. The presence of partially obstructed debris makes these hazards even more prominent. Trip and fall hazards are of special concern for workers at the landfill sites. Stand well clear of well openings and cisterns. Identifying potential trip and fall hazards with a bright flag or marker will reduce the risk of this hazard. First, regular travel pathways between work and staging locations at the site will be established. Foot and vehicular travel will only be permitted along these established pathways. The SSHO will ensure that all personnel are aware of these established pathways. Then, hazards present in the established pathways will be flagged with bright flags or markers to reduce the potential for slips, trips, and falls.

During the 1993 site walk-through, a lot of sharp debris (metal, glass) was noted. When sharp objects are noticed in work areas or collected from excavations, they will be picked up immediately and placed in metal drums. The drums will be disposed of as non-regulated waste in a site landfill cell. The minimum requirements for clothing are described in EM 385-1-1 section 05. All employees, when working in the field, will wear American National Standards Institute (ANSI) approved safety boots with steel shanks and non-slip tread.

3.2.2 CUTS, SCRAPES, AND SLIVERS

Care should be taken to avoid cuts, scrapes, and slivers from recovered debris that includes sharp broken glass, metal containers, barbed wire, shrapnel, wooden posts, wire rope, and cable. Leather gloves must be worn at all times during debris removal. Chain saw or concrete saw usage during debris removal and demolition activities poses the potential for severe lacerations. Operators must wear chaps, hearing protection, hand protection, and eye and face protection.

3.2.3 LACERATIONS

Chain saw, concrete saw, or other power tool usage during debris removal and demolition activities poses the potential for severe lacerations. Operators must wear chaps, hearing protection, hand protection, eye and face protection, and any other personal protective equipment as appropriate and as required by EM-385-1-1 Section 05. Proper use, inspection and maintenance of power tools is described in EM 385-1-1 Section 13. Guarding requirements for power tools (e.g. saws) are described in EM 385-1-1 Section 13.C.

3.2.4 ELECTRICAL SAFETY

Electrical safety will be of concern for those activities using equipment or instrumentation that is powered by electricity. Where there is a potential for underground utilities/cables, these features must be identified and demarcated by persons knowledgeable about the

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existence of such utilities prior to commencing subsurface work. See Section 7.7 for electrical safety standard operating procedures.

3.2.5 FIRE AND EXPLOSIONS

Extreme care should be taken to prevent fire during work on the North Slope due to the arid nature of the site. Internal combustion engines should be outfitted with spark arrectors. Hot work sites should be wetted prior to initiating the activity.

Methane and other explosive landfill gases are produced by the anaerobic decomposition of organic matter in a landfill. Penetration of pockets of landfill gas during field activities and ignition of gas by sparks caused by field operations present a fire and explosion hazard. If odors occur during work, activity will be suspended and the area abandoned until the source of the odors is assessed using monitoring procedures described in Section 5.4. A decision to proceed with work activities will depend on the action levels presented in Section 5.4.4.

3.2.6 UNEXPLODED ORDNANCE

Unexploded ordnance (UXO) is not anticipated to be present at the site. However, the USACE will provide one ordnance expert to be present at the site during all field activities. This individual will provide supervisory support and will be responsible for identifying UXO. They will also provide site-specific training regarding ordnance hazards to members of the field crew. The USACE ordnance plan for the site includes a contingency plan describing procedures and contacts in the event any UXO is encountered. The USACE will be responsible for the disposition of any UXO encountered at the site.

3.3 CONTAMINANTS OF CONCERN

There should be minimal chemical hazards present on the non-CERCLA sites on the North Slope. Since this phase of the work will not involve cleanup around any of the identified

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CERCLA sites, the chemical hazards will not be described in detail at these sites. Potential waste constituents which may present hazards based on the present scope of work are:

- Batteries (metals and acid
- Oils
- Gasoline
- Solvents
- Paints
- Railroad Ties (Creosote)
- Asbestos
- Silica Dust
- Cable Insulation (Asbestos)
- Pesticides and Herbicides
- Methane
- Chemical residuals from Ordnance

While the above list is all of the chemical hazards potentially present, the discovery of any unlisted chemical hazard will be promptly reported to the CQCR/SSHO and the USACE site safety representative.

All containers that may still have contents inside should be treated as though the contents were hazardous waste (workers must be trained for hazardous waste operations). Attachment F describes the sequence of actions to be taken in the event full containers are encountered. Protective equipment should be worn when handling such containers (i.e., protective eye wear and proper hand protection). Containers that have formed crystalline materials around the opening should not be touched. All stained soil should be treated as being possibly contaminated with hazardous waste. If stained soil is detected, workers must notify the CQCR/SSHO. If unusual odors are detected, workers should leave the area, and the field team leader or the CQCR/ SSHO should be contacted for an evaluation of the area.

The following hazardous materials have been identified as potential contaminants of concern in subsurface soil and debris (USACE 1993):

- Asbestos
- Benzene
- Benzo(a)anthracene
- Benzo(b)fluoranthene
- Benzo(a)pyrene
- Cadmium
- Carbon tetrachloride
- Lead
- Lead arsenate
- Methane
- Nickel
- NitrocellulosePentaerythritol
- Polynuclear Aromatic
- Hydrocarbons

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- Chrysene
- Creosote (coal tar creosote)
- Cyanide
- Cyclonite (RDX; cyclotri methylenetrinitramine)
- DDT
- Hydrogen
- Sodium dichromate (tri-nitrotoluene)
- Sulfuric acid
- Tetra-ethyl lead
- Toluene
- Xylene

This list represents the most likely potential contaminants of concern at the H-06-L landfill site. It is possible that other contaminants may be present. Workers should report any unusual odors, symptoms, etc., to the SSHO. Additionally, some contaminants which are of an environmental concern and not an occupational concern may not have been identified in the Safety and Health Plan.

Chemical contact (e.g., skin contact) hazards are potentially present at the site due to contaminated soils and debris. In general, inhalation hazards at the site could be caused by re-suspension of dust into the air from site activities, such as operating equipment. In addition, vapors and gases could be produced by the contaminated soils or debris.

If friable asbestos-containing materials are identified, they will be handled by a USACE contingency contractor. More information on asbestos issues is presented in Section 7.12.

3.4 RADIOACTIVE MATERIALS

There is no history of activities in the North Slope area which might have resulted in radioactive contamination, nor is there reason to suspect the presence of radioactive material as a result of Hanford Site operations. However, radioactive contamination has been detected on the shores of the Columbia River in the past. No personnel will be allowed to work in the vicinity of the river shore.

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Radiation areas that are marked (magenta or yellow tape or signs) shall not be entered. No areas of this type should exist on the North Slope.

A radiation survey has been conducted in the areas to be excavated. Preliminary results indicate no surface or subsurface radiological contamination. CDM Federal will use a Ludlum Micro R meter to conduct periodic radiologic screening during excavation activities. Soil and waste samples will be screened periodically as excavation activities progress. If levels exceed 3X background levels, the USACE Site Safety Officer will immediately be notified and excavation activities will be suspended pending a decision from the USACE.

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4.0 SITE CONTROL

The purpose of site control is to minimize the health and safety risk to the workers and to the public by means of establishing work zones and control procedures. This discussion is pertinent only when potentially hazardous materials/contaminated soils are identified during the landfill characterization and remediation activities based on-site screening (Sections 6.0, 9.5). Only personnel fulfilling health and safety training requirements will be allowed in contaminated areas.

4.1 WORK ZONES

Three work zones will be established at excavation/trenches where hazardous materials/soils have been identified: support zone, contamination reduction zone (CRZ), and the exclusion zone. If contamination is not encountered during excavation/trenching activities these work zones will not be established.

4.1.1 SUPPORT ZONE

Activities in the support zone may include pre-entry briefings, transfer of packages to shipping carriers, field coordination efforts, logging in and out, storage of PPE, contaminant-free equipment and supplies, donning of PPE, and documentation.

The support zone shall be the only zone where eating and drinking is allowed (additional drinking areas may be approved by the SSHO). No smoking will be allowed. The support zone shall always be placed upwind of contaminated areas.

4.1.2 CONTAMINATION REDUCTION ZONE

The CRZ is a buffer zone between the exclusion zone and the support zone where decontamination and doffing of PPE must occur before entering the support zone.

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Leading to the exit point will be decontamination equipment and supplies organized to support moving from a more contaminated area (near the exclusion zone) to a less contaminated area (near the support zone). A contamination reduction zone shall always be placed upwind of contaminated areas. A temporary CRZ may be required for equipment used to excavate stained soil.

4.1.3 EXCLUSION ZONE

Only personnel fulfilling health and safety training requirements (including 29 CFR 1910.120, hazardous waste training, 29 CFR 1910.134, respiratory protection, and 29 CFR 1910.1200, hazard communication) will be allowed in the exclusion zone. The number of personnel within the exclusion zone will keep to a minimum, particularly during excavation of the first few landfill cells. If ordnance is discovered work will be stopped pending further evaluation by the USACE ordnance expert.

The designated exclusion zone will be clearly designed with barrier tape, cones, rope, stakes, or other appropriate markings.

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5.0 PERSONNEL PROTECTIVE EQUIPMENT

To help protect workers from potential site health and safety hazards, minimum personal protective equipment (PPE) requirements have been established. These requirements do not preclude the need to conduct monitoring (see Sections 6.0 and 9.5), nor do they preclude the need to amend PPE requirements as conditions warrant. Any amendment to the minimum PPE requirements must first be approved by the SSHO. Site workers, at their own discretion, may increase, but not decrease, the degree of respiratory protection used.

5.1 TASK SPECIFIC PERSONAL PROTECTIVE EQUIPMENT

The minimum PPE requirements depend on the specific type of activity being performed. These PPE requirements are identified using designations similar to those defined by the EPA as Levels A, B, C, and D. Where slight deviations from EPA's definitions occur, the term "modified" shall precede the term used. In cold weather, insulated coveralls may be worn under Tyvek. Table 5-1 lists the various field activities and the required level of protection.

TABLE 5-1

PPE LEVELS AND ACTIVITIES

Activity	Primary PPE Level	Contingency PPE Level
Excavation/Trenching	D	C
Subsurface Soil/Debris Sampling	D	C

The following PPE ensembles will be established:

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Modified Level D PPE

Employees and subcontractors will be required to wear the following PPE for tasks that the SSHO determines to be Level D:

- Steel toe/shank leather boots (all conditions)
- Disposable overboots (wet conditions or conditions with the potential for exposure to contaminants) or chemical resistant steel-toe boots
- Disposable tyvek or breathable coveralls or cloth coveralls
- PVC rain gear (wet conditions)
- Leather work gloves (dry conditions)
- PVC, nitrile, or neoprene gloves (wet conditions, or conditions with the potential for exposure to contaminants)
- Surgeon's gloves (as needed)
- Hard hat (as needed) or baseball cap to provide protection from sun
- Hearing protection (as needed)
- Safety glasses (as needed)

The SSHO is responsible to determine if conditions present potential for exposure to liquid contaminants. These conditions may require taping of the coverall openings at the wrist and ankle.

Modified Level C PPE

Employees and subcontractors will be required to wear the following PPE for tasks that the SSHO determines to be Level C:

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- Level D PPE as discussed above with the following exceptions:
- Tyvek Coveralls must be worn.
- Latex (surgeon's) undergloves and nitrile overgloves must be worn.
- Full-face air purifying respirator, equipped with GMC-H cartridges (MSA) or equivalent (GMC-H cartridges protect against organic vapors, dust, fume, mists, asbestos-containing dust and mists, and radionuclides)

EPA Level A and Level B are not anticipated for the current scope of work. Other PPE may include earplugs, earmuffs, and high-visibility traffic vests as-needed or as-requested.

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5.2 RESPIRATORY PROTECTION PROGRAM

Employees and subcontractors are required to conform to the requirements of OSHA 29 CFR 1910.134 with regard to respiratory protection. CDM Federal's CHSM is responsible for developing, implementing, managing and evaluating the firm's respiratory protection program. All personnel who may be required to wear a respirator are authorized by a physician to do so. Written standard operating procedures are in Attachment A, (CDM Federal Programs Corporation Corporate Health and Safetv Program, Section 6.0.) Attachment A also outlines training, medical surveillance, storage, cartridge reuse, decontamination, and pressure checking with regard to respirator use. Some guidelines are given below.

Employees and subcontractors will be required to submit evidence of quantitative respirator fit testing to the SSHO prior to performing tasks with the potential for upgrade to Level C. Before using a respirator, employees and subcontractors are required to perform an inspection and checkout in accordance with the manufacturer's instructions. CDM Federal employees will use the MSA Ultratwin (or equivalent) inspection and checkout procedures appearing in Exhibit 5-1.

Facial hair (beards, sideburns, and so forth) that interfaces with the sealing surface of a respirator is not permitted. A "one-day" growth of beard is considered to interfere.

MSA ULTRATWIN INSPECTION AND CHECKOUT

1. Visually inspect the entire unit for any obvious damages, defects, or deteriorated rubber

2. Make sure that the facepiece harness is not damaged. The serrated portion of the harness can fragment which will prevent proper face seal adjustment.

3. Inspect lens for damage and proper seat in facepiece.

4. Exhalation Valve - pull off plastic cover and check valve for debris or for tears in the neoprene valve (which could cause leakage).

5. Inhalation Valve (two) - screw off cartridges and visually inspect neoprene valves for tears. Make sure that the inhalation valves and cartridge receptacle gaskets are in place.

6. Make sure a protective cover lens is attached to the lens.

7. Make sure the speaking diaphragm retainer ring is hand tight.

8. Make sure that you have the correct cartridge.

9. Don and perform negative pressure test.

Exhibit 5.1 MSA Ultratwin Inspection and Checkout

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Employees and subcontractors are required to clean and disinfect respirator protective equipment after each use, or at the end of the day's activities. Respirator wipes may be used for cleaning.

Respirators are required to be stored away from dust, sunlight, heat, extreme cold, excessive moisture, damaging chemicals, and sources of mechanical damage.

5.3 EVALUATION OF HAZARDS

This site is a former landfill which accepted refuse from Nike and anti-aircraft missile sites (H-06). Reconnaissance of the H-06-L Landfill site indicated apparent soil disturbance and surface debris including: paint cans, construction materials, asbestos based materials (transite) and an asbestos brake pad.

Field work during this investigation will be conducted primarily within geophysical anomalies identified during a 1992 investigation. The trenches to be excavated and sampled are located within to the areas which contain refuse from the H-06 Nike/ antiaircraft missile site. It is expected that trash and miscellaneous sanitary debris will be encountered during excavation/trenching activities. The exact limits of the H-06-L Landfill are not known, but geophysical surveys (magnetic, electromagnetic (EM-31) and radar) will be conducted prior to any excavations to determine the presence of buried metallic material (e.g., drums, metal building materials, etc).

The hazards for the H-06-L Landfill site involve physical, chemical and fire hazards. All of the known hazards for this site will be discussed at the initial health and safety kickoff meeting when field work commences. Additional brief "tail-gate safety" meetings will cover hazards which may be encountered daily and serve as a reminder to the overall hazards at this site. Physical hazards will be emphasized at the initial kickoff meeting. Chemical and fire hazards are addressed in Section 5.4.

5.4 CHEMICAL AND FIRE HAZARDS

5.4.1 ORGANIC VAPORS

Air monitoring for total organic vapors (TOV) will be measured with a photoionization detector (PID) equipped with a 10.2 eV lamp or an equivalent instrument, such as a flame-ionization detector (FID). Detector tubes for benzene and vinyl chloride may be used to evaluate the TOV concentrations measured with the PID. Depending on the concentration detected, respiratory protection will be upgraded per the action levels described in Section 5.5.4.

5.4.2 DUST

Airborne particulates present an inhalation hazard. Metals, some of the aromatic hydrocarbons, PCBs and other potential contaminants could enter the body through the inhalation of dust. Air purifying respirators with dust cartridges will be donned in the presence of visible airborne particulates if other site controls are unable to mitigate this condition.

5.4.3 EXPLOSIVE ATMOSPHERES AND IGNITION SOURCES

Some potential causes of explosions and fires include:

- Chemical reactions that produce explosion, fire, or heat.
- Ignition of explosive or flammable chemicals.
- Ignition of materials due to oxygen enrichment.
- Agitation of shock- or friction-sensitive compounds.
- Sudden release of materials under pressure.

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Explosions and fires may arise spontaneously. However, more commonly, they result from site activities, such as moving drums, accidentally mixing incompatible chemicals, or introducing an ignition source (such as a spark from equipment) into an explosive or flammable environment. Explosions and fires not only pose the obvious hazards of intense heat, open flame, smoke inhalation, and flying objects, but may also cause the release of toxic chemicals into the environment. Such releases can threaten both personnel on-site and members of the general public living or working nearby. CDM Federal takes the following precautions to protect against these hazards: personnel monitor for explosive atmospheres and flammable vapor using a combustible gas indicator or equivalent; all potential ignition sources are kept away from an explosive or flammable environment; non-sparking, explosion-proof equipment is used where appropriate; and safe practices are followed when performing any task that might result in the agitation or release of chemicals.

Methane gas is a concern when performing site operations at landfills. Therefore, the lower explosive limits of flammable gases will be monitored during field activities at the H-06-L. Action levels for flammable/explosive gases appear in Section 5.4.4.

5.4.4 ACTION LEVELS

Action levels for Total Organic Vapors (TOV), and flammable/explosive gases are presented below. TOV action levels are based on continuous exposures measured at worker's breathing zone. Activities requiring Level B or higher protection are beyond the scope of this project.

TOV ACTION LEVELS

TOV CONCENTRATION (ABOVE BACKGROUND)	DETECTOR TUBE RESULT	LEVEL OF PROTECTION OR ACTION
< 1 ppm	N/A	Level D
1 - 5 ppm	Benzene < 1 ppm and Vinyl Chloride < 1 ppm	Level D
	Benzene > 1 ppm	Level C
	Vinyl Chloride > 1 ppm	Exit Site
5 - 100 ppm	Benzene < 5 ppm and Vinyl Chloride < 1 ppm	Level C (see note)
	Benzene > 5 ppm or Vinyl Chloride > 1 ppm	Exit Site
> 100 ppm	N/A	Exit Site

Note: Continue periodic monitoring for benzene and vinyl chloride

Flammable/Explosive Gases

(As a % of Lower Explosive Limit)	Action
0-10% LEL	Periodic monitoring
10-25% LEL	Notify SSHO, continue working and monitoring
> 25% LEL	Stop work immediately/evacuate

Oxygen Content	Action
> 25% O_2	Fire hazard potential, interrupt task/evacuate

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19.5-25% O_2	Continue investigation using caution @ low and high ends of specified O_2 range (notify SSHO). Oxygen normal @ 21%.
< 19.5% O_2	Oxygen deficient; interrupt task/evacuate

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6.0 AIR MONITORING

Air monitoring will be conducted within the exclusion zones for specific tasks using direct reading instruments. Work areas will be designated as an approximate 20-foot radius around the work site. For areas where potentially contaminated soils are being disturbed, total dust measurements may be taken of the work area. Alternatively, visible dust may be observed and used as a criterion for evaluatory dust levels. If the ground is wet or weather conditions are rainy, no total dust measurements will be taken. The frequency of measurements also may increase or the measurement may be eliminated based on-site conditions and prior monitoring results. The purpose of these measurements is to verify that total dust concentrations at the work area boundary are less than the action levels. The following action levels, in dust concentration above background, have been established:

- Modified Level D; 1.0 mg/m^3
- Modified Level C; > 1.0 but < 5 mg/m^3

Measurements will be made using a direct-reading total dust indicator (such as a Hazdust or Miniram® PDM-3) following manufacturer's operating instructions. These instruments provide a real time indication of total dust concentrations. The direct reading total dust indicator will be zeroed before each day's use. Because the instrument is direct reading, further analysis will not be required.

For areas where there is the potential for Volatile Organic Compounds (VOC) exposures, air monitoring will be conducted using an Organic Vapor Analyzer (OVA) or an Organic Vapor Monitor (OVM) such as the portable FID or PID, respectively. These instruments are capable of providing a real time indication of total combustible or ionizable VOCs. Measurements will be made following the manufacturer's operating instructions and recorded hourly during intrusive activities; measurements will be made more frequently upon reaching action levels specified in Section 5.4.4. Measurements will be made around the perimeter of the work area and in breathing zones to verify that total VOC concentrations at the work area boundary

and breathing zones are not in excess of action levels specified in Section 5.4.4. The frequency of routine air monitoring of work areas may be increased based on-site conditions and prior monitoring results.

No personal exposure monitoring samples will be collected during activities to be performed at the site. It is not likely that airborne contaminants will result in exposures greater than Permissible Exposure Limits (PELs). In addition, direct reading instruments, such as the PID or FID, and dust indicator, will be used to determine if site personnel are potentially being exposed during site activities.

6.2 EQUIPMENT CALIBRATION

Equipment maintenance and calibration of all monitoring equipment will be conducted according to the manufacturer's specifications (including FID or PID and direct reading total dust indicator). Manufacturer's specifications will be maintained at the field office or with the monitoring equipment.

Equipment calibration shall be recorded in the CQCR's site log book.

7.0 HEALTH AND SAFETY WORK PRECAUTIONS

The health and safety guidelines in this section describe the required actions common to all site activities. These guidelines describe precautions or procedures that are required of all personnel involved in any site activity. These guidelines are not intended to supersede any requirements of EM-385-1-1. In the event of a conflict, EM 385-1-1 will govern.

7.1 GENERAL GUIDELINES

- IMMEDIATELY notify the SSHO of any accidents or near misses.
- Be familiar with the site's emergency response procedures and routes of escape. See Section 9.0.
- Never climb over or under refuse or obstacles that would endanger you or others.
- Hands and face should be thoroughly washed before eating, drinking, using the restrooms, or leaving the site.

7.2 CONTAMINATED SITE GUIDELINES

The following are general guidelines/rules that must be obeyed during all on-site activities in contaminated areas.

7.2.1 BUDDY SYSTEM

Each CDM Federal employee or subcontractor who enters any zone of a hazardous waste operation must be accompanied by a "buddy". The buddy must accompany the partner into the exclusion zone.

Responsibilities of a buddy include the following:

- Provides his or her partner with assistance.
- To be vigilant in observing his or her partner for signs of fatigue, hazardous material exposure, and heat or cold stress including slurred speech, stupor, discoloration, etc.
- Periodically checks the integrity of his or her partners PPE.
- Notifies the SSHO if help is needed.

Because the buddy must provide help, the buddy must be in sight and within hearing distance of his or her partner and must be prepared to enter any area his or her partner enters. Thus, the buddy must be fully certified to work in the level of protection that his or her partner is working in, and must have the appropriate PPE available to him/her. Buddies should establish hand signals to be used in event of an emergency.

Personnel who can provide emergency assistance in the event of injury or illness can serve as a buddy. Appropriately qualified persons who are not CDM Federal employees or subcontractors may serve as buddies when one CDM Federal employee or subcontractor performs, alone, a task that has an accident/injury/exposure potential. Persons who can serve as buddies include:

- CDM Federal employees.
- Subcontractor employees.
- Federal, state, and local regulatory agency employees.
- Facility operators and their employees.

Persons who cannot serve as buddies include:

- Members of the general public, or reporters.
- Clerical staff.

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- Persons not wearing the level of protection used in the work area.
- Persons not certified to wear the level of protection used in the work area.

The use of buddies other than CDM Federal employees or subcontractors is approved only on a case-by-case basis by the CHSM or the SSHO. The buddy must agree to, and be aware of his/her responsibilities as a buddy.

7.3 GENERAL HEALTH AND SAFETY DIRECTIVES

7.3.1 SITE CONTROL AND PERSONAL HYGIENE

The following conditions must be satisfied for work to commence at the site:

- All CDM Federal and subcontractor personnel assigned to work on the site must be provided with a copy of this SSHP and attend a safety briefing before commencing work.
- Material Safety Data Sheets (MSDSs) for all chemicals used will be filed on-site and at CDM Federal-Fairfax and all project personnel will be informed of their location and availability.
- No one will be permitted to work alone on the site -- the buddy system will be followed.
- Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand-to-mouth transfer and ingestion of material is prohibited in any area designated as potentially contaminated.
- Hands and face shall be thoroughly washed upon leaving the work area and prior to eating, drinking, or other activities.
- Whenever decontamination procedures for protective clothing is in effect, the entire body shall be thoroughly washed (i.e., showered) as soon as possible after the protective clothing is removed.
- Medicine and alcohol can increase the effects of exposure to toxic chemicals or can impair a persons ability to work. Personnel using prescription drugs shall inform the doctor who prescribed them of their potential contact with toxic

materials. Field employees who take over-the-counter drugs within a day before work on a site must inform their physician that they intend to perform hazardous waste operations while using the drug.

- Alcoholic beverage intake will be prohibited during project operations. CDM Federal has a drug-free work place policy. Personnel under the influence of alcohol or recreational or illegal drugs will not be allowed on-site, and may face disciplinary action.

- Wearing of beards by individuals assigned to tasks that require or may require respirators will be prohibited. A one-day growth of facial hair that interferes with respirator to face seal is considered to be a "beard".

- All personnel working in exclusion zones must proceed through decontamination before eating, drinking and smoking.

- Before initiating any non-routine operation, personnel must consult SSHO about health and safety requirements for the operation.

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7.3.2 SITE SAFETY PRACTICES

Historically, one of the major causes of physical injuries at sites is slips and falls. To prevent this type of hazard, tools, parts, and other equipment shall not be left lying around. Grease droppings, oils, and sludge shall be cleaned up as soon as possible. Warning signs, railings and covers in place protect against low piping, open tanks, and open manholes or hatches. The simple knowledge of proper lifting techniques -- bending the knees and lifting with muscles of the legs -- can save many strained or injured backs.

There are a host of general practices which require training to ensure personnel safety during operation of the site. Some of the following are detailed, whereas others are self-explanatory in nature.

- Running is forbidden, except in emergencies.
- Moving equipment shall not be operated unless instruction in its use has been given, and use authorized by the SSHO.

- Regulations pertaining to the operation of automobiles shall be observed within the site. These include wearing seat belts at all times when the vehicle is in motion and maintaining speeds under 15 miles per hour.

- Removal of safety equipment or supplies from their normal location must be authorized by the SSHO.

- Safety devices, safety guards, and chains must be in place before operating equipment.

- Improvised staging and structures are not permitted.

- When necessary, certain CDM Federal and site personnel will carry portable radios for emergency and related use. The SSHO will coordinate portable radio communications for emergencies.

- Hand tools and special tools shall be kept clean and in good repair.

- Temporary lines, power cords, and outlets are to be marked, and inspected by the SSHO prior to use.

- Prior to intrusive activities (such as excavation), buried cables and underground utilities will be located.

- The correct tool shall be used for the particular job in the proper manner.

- Carrying materials and tools must be done with concern for overloads and balance, and these items must be securely held.

- Movement with obscured vision shall be avoided.

- Good housekeeping shall be practiced at all times.

- The use of solvents and volatile liquids for periodic cleaning, etc., must first be authorized by the SSHO and proper storage and disposal provided.

- "Horseplay" is forbidden. Horseplay is defined as any frivolous behavior that increases the probability of an accident.

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7.3.3 MATERIAL LIFTING

Many types of objects are handled in normal operation and maintenance at sites. Care should be taken in handling heavy or bulky items because they are the cause of a considerable number of accidents. There are certain fundamentals in the proper lifting of materials to avoid back injuries:

- The size, shape and weight of the object to be lifted must be considered. A worker shall not lift more than one person can handle comfortably.
- The feet shall be placed far enough apart for good balance and stability. THE FOOTING SHALL BE SOLID.
- The worker shall get as close to the load as possible. The legs shall be bent at the knees.
- The back shall be kept as straight as possible.
- The object shall be gripped firmly.
- To lift the object, the legs are straightened from their bend.
- A worker shall never carry a load that cannot be seen over or around.
- When placing an object down, the stance and position are identical to that for lifting. The legs are bent at the knees and the object lowered.

When two or more workers are required to handle an object, coordinating is essential to ensure that load is lifted uniformly and that the weight is equally divided between the persons carrying the load. When carrying the object, each worker, if possible, shall face the direction in which the object is being carried. In handling bulky or heavy items, the following guidelines shall be followed to avoid injury to the hands and fingers:

- A firm grip on the object is essential.
- The hands and object shall be free of oil, grease or water that might prevent a firm grip.

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- The item shall be inspected for metal slivers, jagged edges, burrs and rough or slippery surfaces.

- Gloves shall be used when necessary.

- The fingers shall be kept away from any points that may cause the fingers to be pinched or crushed, especially when setting the object down.

7.3.5 MECHANICAL EQUIPMENT SAFETY

All mechanical equipment will be inspected before it is allowed on the site. The inspection will be performed by the SSHO.

Accidents in using machinery and mechanical devices can be kept to a minimum by designing the machines and the job to prevent accidents. When any mechanical equipment is purchased, all points that affect safety should be considered; past accident experience with the kind of equipment should serve as a guide, and desirable safety features should be specified and included in the original design. When such features cannot be included by a manufacturer, they shall be provided and installed before the equipment is put in operation whenever possible.

Mishandling of machines and tools is a major cause of injuries and breakdown. It is not uncommon to have a new type of equipment put into the hands of workers who are accustomed to another type of equipment and have had no new instruction or training, or untrained workers may be put on the job to learn by experience. All field crew members who operate machinery shall have written documentation on-site showing they have been checked off as receiving training on, and have demonstrated their ability to use, the equipment. These difficulties are not confined to the operation of machinery; they appear in the use of ordinary tools. Some mishaps caused by inattention or lack of skill of an individual cannot be forestalled, but instruction and training can be applied to lower the frequency of this type of accident. Another means of keeping down the tendency to neglect established safety practices and to overlook hazards that develop in mechanical equipment through use is regular

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systematic supervision. The SSHO will ensure that rules and safety practices in the use of mechanical devices are regularly followed and that the equipment is in proper working order, with all the safeguards that have been adopted.

Safety guards are furnished for protection. The following regulations must be followed:

- Remove guards only after equipment has been shut down, tagged, and locked out of service Replace guards as soon as work is completed.
- Make sure guards are in place and operative when using machinery.
- Be thoroughly familiar with equipment before attempting to operate it.
- Do not stand on moving equipment while it is in operation.

7.3.6 EQUIPMENT START-UP AND OPERATION

Rules for safe operation of mechanical equipment may be summarized as follows:

- No machine shall be lubricated or adjusted while in motion, unless its manufacturer specifies this practice.
- Belts, ropes or other moving parts of equipment shall not be guided or controlled by hand or foot.
- Machines shall not be operated unless they are in good working order, properly secured, and all safeguards are in place and in working condition.
- An equipment checklist shall be completed prior to operating the equipment in accordance with EM 385-1-1, Section 16.
- Operators of mechanical equipment shall place themselves in a "safe" position before putting the equipment into operation.
- Repairs or adjustments shall not be made on any equipment until the power has been cut off and the equipment locked securely against all motion. A warning sign will also be attached to the lock.
- Line shafting shall never be oiled while in motion, unless its manufacturer specifies this practice.

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- Machines and apparatus shall not be operated without authorization from the SSHO.

- No person shall use equipment with which that person is unfamiliar or on which that person is uninstructed.

- Adequate clearance shall be provided at machine installation; passageways shall be kept free of stumbling hazards.

- Machines shall be adequately illuminated.

- Steps, handrails, and floors shall be kept free from grease and debris.

7.4 SANITATION AND HYGIENE

In accordance with 29 CFR 1910.120(n), sanitary facilities will be provided to include drinking (potable) water, and toilet facilities. In addition, employees will be provided a clean area for food handling, as appropriate.

7.4.1 POTABLE WATER

The SSHO will identify the closest source of potable water. If not sufficiently close, potable water will be provided in tightly closed containers equipped with a tap. Sanitary, disposable cups will be provided, with a container to dispose used cups. If for any reason, non-potable water is on-site, it will be clearly labelled as such. Any non-labeled water will be potable.

7.4.2 WASHING FACILITIES

The SSHO will provide portable washing facilities located at the H-06-L site which will allow workers to wash after decontamination, prior to leaving the site. Disposable towels, with a container to collect the towels, will also be provided.

7.4.3 TOILET FACILITIES

The SSHO will identify toilet facilities to be located at the site for workers.

7.5 ILLUMINATION

The work will be conducted during daylight hours only.

7.6 MOTORIZED EQUIPMENT

Motorized equipment includes backhoes, dozers, and support trucks. It is important to remember that the operator's visibility may be obscured by the load being handled, dusty conditions, complicated terrain, or other equipment. Some basic standard procedures are:

- Workers must make their presence known, and must wear an orange vest or other easily visible clothing when working near equipment.
- Back-up alarms are required on all equipment, per OSHA requirements in 29 CFR 1926.602(a)(9).
- All motorized equipment must have spark arrestors on exhaust.
- Operators must stay in moving equipment and wait until it stops before getting off.
- Personnel must be aware of rotating equipment. Guards must be in place on all chains and sprockets, revolving shafts, belts and pulleys. Do not wear loose clothing or jewelry. Tie long hair back.
- Personnel must observe traffic patterns and stay out of the way of moving vehicles.
- Personnel must assure that equipment is in working order. Equipment will be checked daily, per OSHA requirements in 29 CFR 1926.601(b)(14).
- Emergency shut-off switches will be identified to all personnel working in the immediate vicinity of motorized equipment.

Catalytic converters on the underside of vehicles are sufficiently hot enough to ignite dry grasses. Do not drive over vegetation which is higher than the ground clearance of the vehicle. Do not take vehicles off the main roads unless they are properly equipped, (e.g., vertical exhaust system, etc.) Contact the WHC Hanford Fire Department if vehicles are to be taken off roadways. USACE is very sensitive to the fire potential of this area. Range fires in these areas are hard to control. Vehicle tire disturbance of all stabilized sites should be avoided. Drive safely, reduce speed to match road conditions; 25 miles per hour should be a maximum speed under the best conditions on unpaved roads.

Use of dirt roadways through the North Slope should be minimized from May through September. Use paved roadways whenever possible. Fire extinguishers (2) and a shovel are required to be carried in field vehicles during fire season (June through October). No smoking is allowed while in the field; extinguish all burning materials. No alcohol or drugs are permitted on the site--the SSHO should be notified of any physical conditions that may present an emergency (e.g., asthma, diabetes, epilepsy, heart problems, etc.)

7.7 ELECTRICAL SAFETY

Overhead power lines, downed electrical wires, and buried cables all pose a danger of shock or electrocution if workers or equipment contact them during site operations. There are no electrical lines in the source area. On-site electrical equipment and lighting may also pose a hazard to workers. The following standard working procedures have been developed to abate these potential electrical hazards:

- Equipment with ground fault interrupters and water-tight corrosion-resistant connecting cable should be used on-site, or an assured equipment grounding program shall be utilized.
- Electrical cords should be inspected for wear daily.
- Electrical cords should be placed so that heavy equipment or repetitive wear is avoided.

- Weather conditions should be monitored and work should be suspended during electrical storms. Equipment operation should be halted, and personnel are to maintain at least a 10-foot distance from equipment in the event of a lightning storm.

- To prevent contact with buried utility lines, the Field Team Leader or his/her designee must contact local representatives of the telephone, electric, and gas companies to have buried lines located and marked. All contact with utility representatives must be documented.

- On-site electrical equipment used in potentially explosive environments will be intrinsically safe.

7.8 CONCRETE CUTTING, HOT-WORK, AND SOURCES OF IGNITION

When welding or other hot-work that may be required for site operations is required, a written "hot-work permit" approved by the SSHO will be required.

Hot-work is defined as any activity capable of producing a spark, flame, or sufficient heat to initiate the combustion or explosion of material being worked on or near. Concrete cutting can cause sparking, especially when it is reinforced. Appropriate protective practices which will be instituted include the following:

- Cover or shield surrounding combustible materials;

- Post a fire watch during and for 1/2 hour after the completion of hot-work;

- The ground surrounding the hot-work must be wetted prior to beginning hot-work; and

- Maintain a 10 lb. ABC fire extinguisher within 10 feet of hot-work (at a minimum).

7.9 FALL AND EXCAVATION SAFETY

Naturally occurring holes, excavations, backfills, and soil removal operations pose physical hazards that include falling, being struck by or caught between moving machinery, and break-

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age or contact with underground or overhead utility lines. Falling into a pit or trench can occur by an unsuspecting person coming upon the hazard, by a person standing too near the hazard and losing balance or tripping, or by a person standing too near the hazard during a wall or face collapse. Falls into a hazard can cause broken bones or suffocation from engulfment. Trenches or excavations 4 feet deep or more shall be considered confined spaces for entry purposes. Furthermore, any work requiring that a worker's head be positioned below ground surface shall be conducted only following confined space entry procedures (Refer to Section 7.11 for additional information).

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Excavations or trenches will be barricaded until backfilling can be completed. All naturally occurring drop-offs will be clearly designated with barrier tape, cones, rope, stakes, or other appropriate markings. All excavations must be performed in accordance with the OSHA Standard 29 CFR 1926.650 -1926.653, and air monitoring instruments shall be used to monitor the work area. These requirements include:

- Placing excavated soil at least 2 feet from the edge of the excavation.
- Appropriate handling of the excavated soil.
- Allowing no person under a load.

7.10 CONTAINER HANDLING

Handling of containers with residuals is not anticipated at Hanford North Slope, although if containers with residuals are discovered, the following standard procedures must be followed. Sampling/handling containers of "unknowns" is a highly hazardous operation; thus, planning is essential. The potential hazards include fire, explosion, vapor generation, and physical injury resulting from moving heavy containers.

- No containers will be opened without the presence of an USACE QA Representative, Field Team Leader, or Safety Officer.
- Eliminate all sources of ignition (smoking and spark-producing equipment).

- Containers will not be opened in less than Level C protection.
- Use a Combustible Gas Indicator (CGI) to monitor the area for combustible vapors.
- Locate a 10 lb. ABC fire extinguisher within 10 feet of the area (at a minimum).
- Do not handle or sample containers, although visual inspection of containers to obtain as much information as possible about their contents and condition will be performed. Visual inspection will not involve handling. The container inspections should not be performed closer than 10 feet away until field screening has been completed.
- Be prepared for leaks and spills. Have an adequate volume of absorbent near the sampling area to contain small spills.
- In general, when opening a container, do not lean over the access port. If possible, vent excess pressure if volatile substances are stored in the container.
- Do not stand on containers.

7.11 CONFINED SPACE ENTRY

This scope of work does not contain any investigations which require confined space entry. Confined spaces are characterized as not being designed for human occupancy, having limited entrance and exit access points, and having the potential to create a hazardous environment (e.g., toxic, oxygen-deficient, or unstable).

Should entry into a confined space be required, specific confined space entry training will be required. In addition, a written entry permit, to be approved by the SSHO, will be prepared to document the precautions required for entry, results of air testing for oxygen content and flammable gases, and procedures to be used in the event of an emergency. The requirements of General Safety & Health Requirements Manual EM385-1-1, Section 6 will be strictly enforced.

7.12 ASBESTOS HANDLING

A USACE site safety representative, qualified for asbestos-awareness, will be on-site during all excavation activities and will be responsible for recognition if friable and non-friable asbestos. Non-friable asbestos is non-regulated, thus if encountered, it will not require any special handling. If friable asbestos is encountered during excavation activities, the USACE will call in a contingency contractor, trained in asbestos handling, packaging, monitoring and disposal. The contingency contractor will be responsible for all handling and removal of friable asbestos.

7.13 FIRE EXTINGUISHER

The SSHO will maintain fire extinguishers (10 #; Class A, B, C) on-site during all work activities and will ensure that all subcontractors understand the different classes and their intended use.

7.14 DRUG FREE WORK ENVIRONMENT

As required by federal legislation, CDM Federal has adopted the following policy regarding the Drug-Free Workplace Act. It is the firm's policy to maintain a productive and safe workplace free from the influence of illegal drugs. In accordance with federal funding and contracting requirements, the firm strictly prohibits the unlawful manufacture, distribution, dispensation, possession, or use of illegal drugs or controlled substances by any employee on or near the firm's premises, or job sites or vehicles or during working hours. Use of illegal drugs or controlled substances before reporting to work which affects workplace performance or conduct is likewise prohibited.

Violation of this policy will result in appropriate discipline, up to and including immediate discharge. Employees are cautioned that discipline under this policy may include satisfactory

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participation in a drug abuse assistance or rehabilitation program as a condition of continued employment.

Any employee who is convicted of violating a criminal drug statute for conduct occurring in or near the workplace must notify the firm no later than five days after conviction. Failure to notify the firm in a timely fashion will result in discharge.

In compliance with the Drug-Free Workplace Act, employees are required to sign a statement that they have received a copy of the firm's policy and that they will abide by its terms. CDM Federal will terminate the contract of any subcontractor who violates CDM Federal's drug free work environment policy.

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8.0 DECONTAMINATION

8.1 PERSONAL HYGIENE

Washing facilities will be established in the support zone of the site (if present). The facilities will include water, soap, means of drying, and receptacles for waste. An adequate supply of drinking water will be available in the support zone at the site. Water coolers or sources of bottled water will be clearly marked as drinking water so they will not be used for other purposes.

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8.2 DECONTAMINATION

It is not anticipated that equipment will come into direct contact with pure contaminants. The more likely scenario is physical contact of equipment with materials, such as soils, that may be contaminated. Removal of contaminants such that equipment and tools are visually free of potentially contaminated soil can be adequately accomplished using dry decontamination methods (e.g., brushing) and/or washing in a detergent solution (e.g., Alconox and water). Details of dry decontamination methods for excavation equipment are described in the Work Plan.

Portions of the sampling equipment that have directly contacted contaminated soils will require decontamination. Decontamination of sampling equipment (such as stainless steel spatulas, spoons, bowls, or shovels) is done using the following steps:

Step 1: Alconox detergent wash

Step 2: Tap water rinse

Step 3: Distilled water rinse

Step 4: Air dry away from potential sources of contamination (e.g., splashes)

Decontamination of personnel exiting the exclusion zone or work areas with Modified Level D PPE (or Modified Level C PPE, if required) will use the following steps in the CRZ:

Step 1: Brush soils from boots (dry) for Modified Level D or, for Modified Level C, scrub boots with decontamination solution (liquinox).

Step 2: Remove outer gloves (if in Modified Level C PPE).

Step 3: Remove hardhat (if required) and wipe clean.

Step 4: Remove and discard outer suit (in Modified Level C, roll suit outward to avoid skin contact with suit's exterior).

Step 5: Remove respirator face piece (for Modified Level C). Dispose of respirator cartridges at least weekly, or sooner if breakthrough or increased breathing resistance is experienced. Clean respirator face piece with damp cloth, followed by an alcohol wipe. Periodically the respirator should be disassembled and washed with mild detergent solution and air dried.

Step 6: Discard inner gloves.

Step 7: Depart CRZ in work clothes and boots.

Step 8: Wash hands, face, and neck before eating, drinking, using restrooms, or leaving the site.

8.3 EQUIPMENT

Decontamination equipment that will be used on-site is listed below. The type and amount of decontamination equipment present at the site at any given time will vary, depending on the specific tasks being accomplished at that time.

- Collection containers, such as drums or suitably lined trash cans, for storing disposable clothing and heavily contaminated personal protective clothing or equipment that must be discarded.
- Plastic sheeting, sealed pads with drains, or other appropriate methods for containing and collecting contaminated wash and rinse solutions spilled during decontamination.

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- Wash solutions selected to wash off and reduce the hazards associated with the contaminants.

- Rinse solutions selected to remove contaminants and contaminated wash solutions.

- Long-handled, soft-bristled brushes to help wash and rinse off contaminants.

- Paper or cloth towels.

- First aid kit, fire extinguisher, and portable eyewash solution.

- PPE and respirator alcohol wipes.

- Washtubs.

- Soap or wash solution, wash cloths, and towels for personnel.

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8.4 INVESTIGATION - DERIVED WASTES

All investigation derived wastes will be handled according to Section 4.48 of the H-06-L Work Plan.

- Suspected or confirmed hazardous materials excavated from landfill cells will be staged on Port-A-Pads.

- Potentially contaminated PPE will be placed in a drum and will be staged on a Port-A-Pad.

- Decontamination water will be containerized and sampled to determine appropriate disposition. Containers will be staged on a Port-A-Pad.

- Non-regulated wastes which originated in the H-06-L landfill will be returned to the disposal cells.

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9.0 EMERGENCY RESPONSE AND ACCIDENT PREVENTION

In the event of an emergency, the CQCR/SSHO will be notified immediately by voice or radio. First aid treatment other than for very minor cuts or abrasions should be accomplished at a nearby medical facility. Only persons certified in cardiopulmonary resuscitation (CPR) and first aid will be allowed to perform CPR and first aid, respectively. Medical treatment may be obtained at Kadlec Medical Center. A map illustrating the route from the sites to the medical facility and presenting directions to the medical facility is presented in Figure 9-1. Police, fire, or medical assistance can be summoned by dialing 911. Alternatively, the Mattawa Fire Department can be reached at (509) 572-0119.

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The local emergency services agencies will be relied upon to respond to emergencies. Initial action by site workers, should an emergency incident occur, is described below.

Personal Injury in the Exclusion Zone: Upon notification of an injury in the exclusion zone, site personnel shall assemble at the decontamination line. The rescue team will enter the exclusion zone (if required) to remove the injured person to the CRZ. The CQCR/SSHO should evaluate the nature of the injury, and the affected person should be decontaminated to the extent possible prior to movement to the support zone. On-site personnel shall administer the appropriate first aid, and an ambulance should be contacted at the designated medical facility (if required; see route map in Figure 9-1). No persons shall re-enter the exclusion zone until the cause of the injury or symptoms is determined.

Personal Injury in the Support Zone (or Debris Removal Sites): Upon notification of an injury in the support zone, the CQCR/SSHO will assess the nature of the injury. If the cause of the injury or loss of the injured person does not affect the performance of site personnel, operations may continue, with on-site personnel initiating the appropriate first aid and necessary follow-up. If the injury increases the risk to others, on-site activities will be stopped until the added risk is removed or minimized.

From the Site:
Take 24 West 19.5 miles
to 240 East into Richland

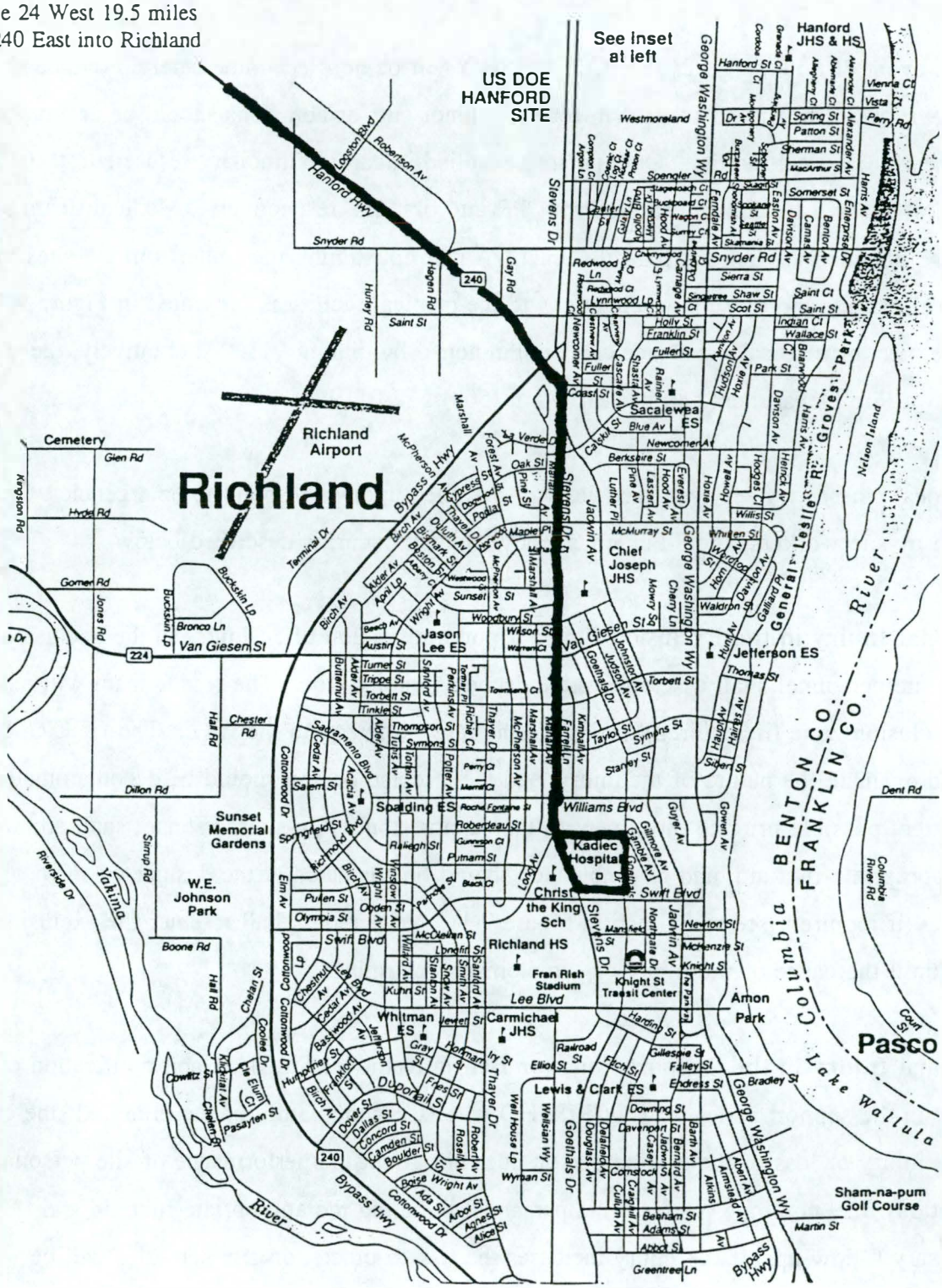

Figure 9-1 Route Map to the Kadlec Medical Center

Fire/Explosion: Fires should be put out as soon as possible. Upon notification by the SSO or realization of an uncontrollable fire or an explosion on-site, all site personnel will evacuate. The fire department shall be alerted as soon as possible.

Personal Protective Equipment Failure: If any site worker experiences a failure or alteration of protective equipment that affects the protection factor, that person and his/her buddy shall immediately leave the exclusion zone or debris removal site. Re-entry shall not be permitted until the equipment has been repaired or replaced.

Other Equipment Failure: If any other monitoring equipment on-site fails to operate properly, the SSO shall be notified to determine the effect of this failure on continuing operations. If the failure affects the safety of personnel or prevents completion of scheduled tasks, all affected personnel shall leave the exclusion zone until the situation is evaluated and appropriate actions are taken.

9.1 EMERGENCY EQUIPMENT

Emergency equipment will be readily available in the event of an accident. The equipment to be available will include:

- Emergency eyewash equipment meeting the requirements of ANSIZ-358.1 will be available in each vehicle used for site activities;
- Air horn (for evacuation notification, 1 prolonged blast);
- Two 10 lb. ABC-rated fire extinguishers in each vehicle used for site activities;
- First aid kit with equipment adequate for the number of site personnel; and
- Spill kit containing absorbents and protective equipment to be used in the event of contaminated liquid spillage.

Medical assistance is readily available in the local community (see attached route map-Figure 9-1). The closest emergency trauma care center to Kadlec Hospital located in Richland.

Maps will be posted in the vehicles. A list of CPR/first aid certified personnel will also be posted in the support zone.

An emergency eyewash shall be available at all sites where drilling or groundwater sampling is conducted. All vehicles shall be assigned a shovel, 2-10 lb. ABC-rated fire extinguishers, and a pair of wire/bolt cutters.

9.2 OTHER EMERGENCY CONTACTS

The primary points-of-contact on safety or health-related matters at the site, as shown on Table 9-1, should be notified in the event of an accident or near-miss incident. (A near-miss incident is one that could have caused a loss of limb or life.)

9.3 ACCIDENT REPORTING

Accidents or near-miss incidents that occur on-site will be reported to the SSHO. The SSHO will investigate the accident or near-miss incident and complete the required accident investigation reports. Any accident, spill, or unusual occurrence will be reported to the USACE Safety and Health Supervisor as soon as possible. Copies will be filed at the field office and provided to the employees involved and their supervisors/companies. In the event of an injury (Washington Industrial Safety and Health Administration [WISHA]/OSHA recordable) involving two or more workers or a fatality, the WISHA and OSHA officers will be notified within 24 hours.

All accidents, near-misses, deficiencies, etc., will be recorded in the daily log.

9.4 SAFETY AND HEALTH INSPECTIONS

Health and safety inspections will be conducted routinely by the SSHO. Deficiencies observed during health and safety inspections will be referred to appropriate supervisory personnel for corrective action.

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Table 9-1.
Primary Contacts and Emergency Notification Personnel List

Organization	Name	Phone (working hours)*
Police/Fire/Ambulance		911
Kadlec Medical Center	Emergency/Trauma Care	(509) 946-4611
Site Safety and Health Officer (SSHO)	Paul Karas	(509) 943-5828
CDM Federal	Charles Myers	(703) 968-0900
USACE,Safety Office		
Walla Walla	Wendy Alenduff	(509) 522-6316
Richland	Mike Remington	(509) 376-9607
	Pager	(509) 522-9758
Resident Engineer	Mike Mahoney	(509) 376-9580
Program Manager	Jane Gardner-Clayson	(509) 376-9719
Technical Manager	Randy Chong	(509) 522-6774
Field Team Leader	Rich Fink	(509) 520-1178
Mattawa Fire Department		
	Emergency	572-0119
	Non-emergency	932-4777
Hanford Dispatch		(509) 373-2745
U.S. Fish and Wildlife Service	Dave Geoke	(509) 488-2668
END Pager	Occurrence Reporting	(509) 546-6264
END Cellular	Occurrence Reporting	(509) 544-8226
State Department of Fish & Game	Bob Kent	(509) 765-6641

Note: Ordnance discovery emergency contact list is presented in the USACE Ordnance Plan.

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9.5 AIR MONITORING

9.5.1 EXPOSURE MONITORING

The SSHO will perform exposure monitoring to ensure that employees and subcontractors are not exposed to chemical contaminants above established exposure limits as described in Section 5.4.4.

Personal monitoring will consist of taking breathing zone and area measurements using direct reading instruments during work tasks that have the potential for exposure.

Environmental monitoring will consist of taking area measurements using direct reading instruments during work tasks that have the potential to produce airborne contaminants that may migrate offsite.

A PID and Draeger detector tubes will be used for personal and environmental, organic vapor monitoring. The Gastector Hydrocarbon Surveyor Model 1314 will be used for environmental monitoring to ensure that explosive atmospheres are not encountered.

For the activities planned at the H-06-L Landfill site, air sampling utilizing fixed and personnel samplers is not deemed necessary. In addition, meteorological monitoring will not be performed. For these reasons, sampling and analytical methods have not been specified, nor have laboratory qualifications been discussed.

9.5.2 EXPOSURE MONITORING EQUIPMENT

The presence of organic vapors throughout the site area and in breathing zones will be determined using a PID. The PID is a direct reading instrument that responds to the presence of ionizable gases and vapors at atmospheric concentrations above 0.1 ppm. The control of measurement and test equipment is described in SOP 5-1 in Attachment C. Instructions for operation and maintenance of the PID and other field instruments will be available on-site. In

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addition, Draeger detector tubes will be used for contaminants with low PELs (i.e., Benzene, Vinyl Chloride). To use the Draeger calorimetric tubes, first break off both tips of the tube in the break-off eyelet. Insert the opened Draeger tube in the pump head so that the arrow points towards the pump. Compress the bellows completely and then release it. The end of the suction movement is reached when the limit chain is completely taut. When testing, make the number of pump strokes specified in the operating instructions for the tube concerned.

9.5.3 GASTECTOR HYDROCARBON SURVEYOR MODEL 1314

During trenching intrusive tasks, the GH Model 1314 (or equivalent) will be used to determine if explosive atmospheres exist. The action levels specified in Section 5.4.4 will be used to ensure work activities are conducted in a safe and stable environment.

9.5.4 INSTRUMENT CALIBRATION

All standard operating procedures, including calibration methods, for the PID and the gastector hydrocarbon surveyor will be available on-site.

9.6 EXPOSURE/INJURY/ILLNESS/ACCIDENT REPORTING

The purpose of the exposure/injury/illness/accident reporting system is twofold: to learn from past mistakes in order to maintain an hazard free work environment, and to document occupational injuries and illnesses as required by OSHA. The system consists of monthly incident reports and injury/illness/accident reports. All incidents involving exposure, injury, illness,and accidents damage are thoroughly investigated by the CHSM, as are incidents that might not cause injury, or illness, but had the potential to do so ("near miss incidents"). All accidents and incidents will be reported by phone to the USACE a the following numbers:

(509) 522-6316 (Walla Walla)
(509) 376-9601 (Richland)
(509) 522-9758 (Pager)

Details regarding CDM Federal corporate incident reporting requirements can be found in Attachment A, CDM Federal Programs Corporation Corporate Health and Safety Program, Section 5.0.

Forms and procedures for DOE Occurrence Reporting will be maintained on-site.

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10.0 TRAINING

All on-site persons conducting site reconnaissance, stained soil sampling, and soil removal are required to have completed training in accordance with 29 CFR 1910.120 (HAZWOPER), 29 CFR 1910.1200 (Hazard Communication), and 29 CFR 1910.134 (Respiratory Protection). Those persons responsible for supervising field activities must have 8 hours of training in addition to the initial 40 hours of training required of all site workers (per 29 CFR 1910.120). Those persons conducting debris removal are required to have completed training in hazard communication (29 CFR 1910.1200 and 296-62 WAC, Part C). Training requirements for each site employee will be reviewed by the SSHO to ensure compliance with regulations. Any worker exposed to friable asbestos shall have training in accordance with 29 CFR 1910.134, 1001 and 40 CFR 763.120, 121.

An initial (pre-entry) safety meeting will be held just prior to the start of on-site work. This safety meeting will be documented, and questions about the Site Safety and Health Plan will be answered. The pre-entry safety meeting will review site safety rules and prohibitions, locations of emergency equipment such as eye wash stations and fire extinguishers, escape routes, accident reporting, directions to the nearest medical facilities, how to summon medical assistance, and protective equipment requirements for the activity to be done.

Safety briefings will be held daily. These safety meetings will be held, to address hazards which may be encountered, special field activities, deficiencies noted, or procedural improvements that could be made based on the site activities. Safety meeting logs documenting the subject matter covered will be completed for every safety meeting held, and all workers will be required to sign the safety meeting log. Copies of these logs will be provided to the USACE field representative.

All workers on-site will be required to sign the signature page at the front of this document to indicate that they have reviewed this plan and are responsible for implementing it. Respirator fit test, and training certifications for CDM Federal staff and sub-contractors will be maintained on-site. All members of the field crew have stop work authority in the event that

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they believe an unsafe situation exists. Employees are responsible for their own actions. Violations of safety requirements will not be tolerated and may result in removal from the job site.

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11.0 MEDICAL SURVEILLANCE

A medical surveillance program meeting the requirements of 29 CFR 1910.120 and ANSI Z-88.2 is required for personnel performing site reconnaissance, soil sampling, and excavation. WISHA (296-62 Part P) and OSHA (29 CFR 1910.134) require that all workers who may be required to wear respirators be medically qualified. Medical examinations must include a physician's written opinion as to fitness for duty and the ability to use personal protective equipment.

Respiratory protection may be required if field instruments indicate elevated levels of airborne contamination. Modified Level D PPE is planned for most field site personnel. Documentation of the medical qualifications of any CDM Federal employees or subcontractors will be maintained on-site. Guidelines that can be provided to the examining physician to establish fitness of individuals for work at the site are available (National Institute of Occupational Safety and Health [NIOSH] 1985).

As part of the medical surveillance program, pre-employment screening should include:

- Medical history;
- Occupational history;
- Physical examination;
- Determination of fitness to work wearing protection equipment; and
- Baseline monitoring for contaminants of concern.

Periodic (annual) medical examinations should include:

- Update of medical history;
- Update of occupational history;
- Physical examination; and
- Monitoring, if warranted by examination results or exposures.

Medical certification for CDM Federal Employees who may work on the site appear in Attachment B.

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12.0 RECORDKEEPING

The safety and health-related records or logs required to be maintained at the site are:

- Training records for all personnel;
- Daily safety inspection logs (may be part of other daily logs);
- Accident reports;
- Employee/visitor register;
- SSHO field and safety meeting notes;
- Medical opinions/certifications for fitness for duty and ability to use PPE; and
- Site-specific environmental and employee exposure monitoring records.

Safety records pertaining to monitoring, medical surveillance, etc., shall be kept for a minimum of 75 years in accordance with DOE Orders.

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REFERENCES

U. S. Army Corps of Engineers, (USACE), 1992 Safety and Health Requirements Manual, EM 385-1-1, U.S. Government Printing Office, Washington, D.C.

USACE, 1993 Site Safety and Health Plan for Physical Hazard Removal.

U.S. Department of Health and Human Services, 1985 NIOSH/OSHA/VSCG/EPA/Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, U.S. Government Printing Office, Washington, D.C.

U.S. Environmental Protection Agency, (EPA) 1984, Standard Operating Safety Guides, U.S. Government Printing Office, Washington, D.C.

U.S. EPA, 1988 Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA. EPA/540/G-89/004, U.S. Government Printing Office, Washington, D.C.

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ATTACHMENT A

HEALTH AND SAFETY

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4.0 MEDICAL SURVEILLANCE PROGRAM

4.1 INTRODUCTION

The medical surveillance program consists of a combination of: (1) baseline, annual, interim, and exit examinations; (2) services for the evaluation and followup of occupationally related injuries and illnesses; and (3) emergency medical services required to stabilize severely injured or ill patients prior to their transport to an offsite medical care facility. The Medical Surveillance Program is designed and administered by a board certified, occupational physician.

Medical monitoring protocol for personnel assigned to hazardous, or potentially hazardous, waste sites is provided in Table 4-1.

All CDM Federal field personnel will be provided with a thorough, initial baseline medical examination to assess fitness for the job and to provide baseline health data for subsequent reference. Examination will be repeated annually unless abnormal test results or other problems dictate more frequent observation.

During the medical examination, employees will be evaluated for their ability to wear respiratory protection and other protective equipment (e.g., extensive clothing ensembles). This evaluation will include, as a minimum, an examination of the cardiopulmonary system, i.e, forced vital capacity (FVC) and forced expiratory volume--1 second (FEV 1.0). When indicated by the physician other tests of the respiratory and cardiovascular systems will be performed on the basis of an individual's past history, findings of the above evaluation, and/or the type of equipment the individual may be required to use.

A sample medical authorization for is provided in Figure 4-1.

4.2 BASELINE MEDICAL EXAMINATION

The baseline medical examination is conducted to determine whether an employee is physically and mentally suitable to perform work requirements and assignments as outlined in the job description, to provide baseline values for comparison with later test results, and to evaluate the ability to utilize personal respiratory protection and other protective equipment. The baseline medical examination will include, as a minimum:

- A medical and work history
- Physical examination which includes vital signs and an evaluation of all major organ systems
- Audiogram
- Vision screening

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- Chest x-ray (only if there was not an x-ray within 12 months)
- Blood chemistry screen and profile
- Urinalysis
- Spirometry.

4.3 ANNUAL/INTERIM MEDICAL EXAMINATIONS

Annual/Interim medical examinations will be given every 12 months or more frequently if indicated by substandard performance; evidence of particular stress or difficulty in using personal respiratory protection; signs/symptoms of illness commonly associated with chemicals present at the site; or if employees were exposed while unprotected. Employees experiencing signs and symptoms or having complaints must immediately report the problem to the HSC or to the CHSM. Employees having abnormal test results will also be monitored and rested by the physician at intervals prescribed in appropriate federal codes (29 CFR, i.e., 1926.52, 1910.134, 1910.1001, 1910.1025, 1910.1018, and 1910.120).

Components are similar to the baseline examination. Following the annual or interim examination the physician will submit in writing to the HSC and the CHSM any medical and safety restrictions required and the physician will inform the employee of the test results. The physician will indicate the reasons for restricting work and will submit an appropriate plan of medical supervision for any work-related illnesses or injuries.

4.4 EXIT MEDICAL EXAMINATION

If employment is terminated voluntarily or involuntarily an exit medical examination will be offered.

Content of the exit medical examination will incorporate those elements included in the baseline examination. Signs or symptoms of work-related illnesses will be reported immediately.

An employee who refuses to submit to an exit examination will be advised of the potential hazards and will complete a waiver form stating that the employee has been advised of the need for an examination, has voluntarily refused an examination, and waives the right to future litigation relative to conditions which may have been detected in the course of the examination.

Valid attempts to contact employees who terminated employment without an exit examination will be made. A record of efforts to contact employees who leave employment without notice and without undergoing an exit examination will be kept. The record will become part of the employee's medical records.

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4.5 RETURN-TO-WORK EXAMINATIONS

An employee desiring to return to work following a leave of absence due to injury or illness, or return to full status from a restricted work period resulting from an injury/illness will have to obtain clearance by means of a physical examination. Extent of the physical examination will be determined by the Occupational Physician and will be performed at the locally established medical services provider.

4.6 ACCESS TO EMPLOYEE MEDICAL RECORDS

In compliance with 29 CFR 1910.120, all CDM Federal employees and their designated representatives have access to their own medical records developed as part of this program. Employees must request the records, in writing; and specify the name, address, and telephone number of the physician who is to receive the records. Such requests are to be sent to the CHSM. The request for medical records appears in Figure 4-2.

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5.0 INJURY AND ILLNESS PREVENTION

5.1 INTRODUCTION

CDM Federal believes that the health and safety of each of its employees is of utmost importance. The prevention of occupationally induced illnesses and injuries takes precedence over operating productivity at all times. CDM Federal provides quality supervision: training and education opportunities: and protective clothing and equipment to ensure that maximum employee health and safety protection is provided.

CDM Federal's objective is a health and safety program that reduces the number of illnesses and injuries to an absolute minimum. This objective is not merely in keeping with, but to surpass the best experience of the industry. CDM Federal's goal is zero accidents and injuries.

CDM Federal's corporate strategy to achieve this goal includes the following:

- **The identification and employment of quality employees.** In addition to a detailed interviewing session previous employment record checks, investigation into education and training, and personal reference checks are all tools utilized to evaluate potential employability.

- **Quality, consistent, and ongoing health and safety training programs.** CDM Federal's training programs are designed to exceed those required in OSHA standard 29 CFR 1910 and 29 CFR 1926. These programs represent the industry standard.

- **Identification and appraisal of accident and loss producing conditions and practices.** This basically consists of a detailed hazard analysis of materials, materials handling operations, and materials handling systems including advanced and detailed studies of all hazard potentials. A review of this analysis along with staffing requirements is also accomplished.

- **Development of accident prevention and loss control methods, procedures, and programs.** Using knowledge in accident causation and control elimination of causation factors is the goal of this program element. This is accomplished through the establishment of methods, development and procedures, and the education of supervisors and managers.

- **Communication of accident and loss control intervention to all layers of management.** This element is accomplished with an accident information management system. With formatted information provided on the accident report form, a signature is required by the project manager and the appropriate office manager before being sent to Corporate headquarters. The system allows for the generation of required documents (i.e., OSHA 200) as well as tracking and sorting accident type, cause, etc. This information is summarized and distributed

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throughout all management levels.

- Assigning accountability and responsibility to all employees for implementation and maintenance of methods, procedures, and practices involved with the health and safety program. Each branch office has a designated HSC that oversees the implementation of all program elements on a day-to-day basis and to instill and motivate proper attitudes towards health and safety with all branch office employees.

- Measurement and evaluation of the effectiveness of the accident and loss control system. Annual summaries of frequency, type, and cost of accidents are used to evaluate program effectiveness. Quarterly summaries allow for trend and statistical analysis.

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On a project-specific level, CDM Federal develops and implements detailed, site-specific health and safety plans (HSPs). The development of these plans begins prior to mobilization with a detailed review of all information currently available on the project. Contaminants present, operations to be performed, and health and safety hazard potentials are all reviewed for incorporation in the HSP.

Functions that may be performed by the HSC and/or the CHSM at this time include the following:

- Assessment of materials present and calculation of potential airborne concentrations which can reasonably be anticipated during all operations.

- A review with CDM Federal's occupational physician of the materials expected to be presented at the job site, anticipated exposure concentrations, and the physical requirements of the work to be performed so that an appropriate project-specific health surveillance program can be designed.

- Based on information provided and anticipated, levels of protection are assigned for operations with exposure potential.

- A review of the site characteristics is performed so that an appropriate ambient air and employee exposure air monitoring program can be developed.

- Assessment of potential physical hazards including equipment operation, exposures to temperature extremes, hearing conservation, etc.

CDM Federal is committed to the policy that health and safety is a part of production and not apart from production. Further, CDM Federal believes that its people are its most important asset and that employee health and safety must receive top priority, support, and participation from all management levels.

5.2 ACCIDENT REPORTING AND INVESTIGATION

The "Injury/Illness Report Form" (Figure 5-1) will serve as the basis for the written reporting and investigating of all accidents resulting in employees receiving more than nonintrusive first aid.

All such accidents are to be verbally communicated to the office HSC or the Section or Branch Managers as soon as medical services are secured. These individuals will verbally notify the CHSM within 24 hours of the accident.

Necessary medical services and employee care is to be secured prior to the initiation of reporting and investigation.

The investigation is to be thorough and performed, at a minimum, by the injured employees' immediate supervisor. The results of the investigation are to be documented using the report form, to be signed by the investigator. The form is then sent to the appropriate Section or Branch Manager, who, following a review, is also required to sign the form before forwarding it to the office HSC. Following the HSC's review and signature, a copy of the form is to be made for the office/project file, with the original forwarded to the CHSM.

Required completion of a customer form cannot be substituted for the CDM Federal form, i.e., both forms are to be completed.

The form is to be completed for all accidents, including CDM Federal employees and subcontractor's employees. In the event of an accident to a subcontractor employee, the form and investigation are to be prepared and performed by the subcontractor.

5.3 FOLLOW UP

If the injury/illness resulted from the uncontrolled release of hazardous material, the CHSM is to be notified immediately so that discussions with the occupational physician can occur to determine if additional biological monitoring should be prescribed.

As soon as practical, following the initial medical treatment, the injured employee is to be scheduled into the clinic which administers the annual examinations for the injured employee's office. This is necessary to ensure that the employee receives quality medical treatment during any type or recovery period. This does not apply to a subcontractor employee.

The CHSM and the HSC will follow up with the project manager to ensure that corrective action, if identified in the "Injury/Illness Report Form," has been implemented.

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6.0 RESPIRATORY PROTECTION

6.1 APPLICATION, PURPOSE, AND SCOPE

Application - This operating procedure applies to all employees performing duties requiring the use of respiratory protection to prevent unnecessary exposure to airborne concentrations of toxic materials equal to or greater than the permissible limits established in the existing Occupational Safety and Health Standards (29 CFR 1910.1000).

Purpose and Scope - To provide information necessary to ensure CDM Federal's respiratory protection programs are consistent with Occupational Safety and Health Standards (29 CFR 1910.134).

6.2 DEFINITIONS

Approved - Tested and listed as satisfactory by the National Institute for Occupational Safety and Health (NIOSH) and/or the Mine Safety and Health Administration.

Contaminant - A harmful, irritating, or nuisance material in concentrations exceeding those normally found in the ambient air.

Disinfection - The destruction of pathogenic organisms, especially by means of chemical substances.

Immediately Dangerous to Life or Health - Conditions that pose an immediate threat to life or health, or conditions that pose an immediate threat of severe exposure to contaminants which are likely to have adverse delayed effects on health (includes oxygen deficient atmospheres).

Oxygen-Deficient Atmosphere - An atmosphere containing 19.5 percent or less of oxygen by volume.

Particulate Matter - A suspension of fine solid or liquid particles or fibers in air such as dust, fog, fume, mist, smoke, or sprays.

Pneumoconiosis-Producing Dust - Dust which when inhaled, deposited, and retained in the lungs may produce signs and symptoms of pulmonary disease.

Respirator - An approved device designed to provide the wearer with respiratory protection against inhalation of a contaminated atmosphere and, for some devices, oxygen-deficient atmospheres.

Vapor - The gaseous state of a substance that is solid or liquid at ordinary temperature and pressure.

Dusts - Solid particles, mechanically produced, with a size ranging from submicroscopic to macroscopic.

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Fumes - Solid particles generated by condensation from the gaseous state, generally after volatilization from molten metals, with a size usually less than 1 micrometer in diameter.

Mists - Suspended liquid droplets generated by condensation or by breaking up of a liquid with a size ranging from submicroscopic to macroscopic.

Gases - Substances which are gaseous at ordinary temperature and pressures.

6.3 GENERAL REQUIREMENTS

Respirators will be considered an acceptable method of protecting the health of CDM Federal personnel only under the following circumstances:

- When it has been determined that there are no feasible engineering or work practice controls that can be used to adequately control the hazard
- During intermittent, nonroutine operations (1 hour/day for 1 day/week)
- During interim periods when engineering controls are being designed and/or installed
- During emergencies
- As part of a safety procedure where a possibility for an excessive or potentially hazardous condition has been defined.

The multiplicity of hazards that may exist in a given operation requires a careful and intelligent respiratory selection. The selection is made complex by the many types of respirators available. Each type has its special limitations, application, operational and maintenance requirements. For these reasons it is important that the individual supervising a respiratory program be familiar with the OSHA Standard and trained and knowledgeable in the basic principles of respiratory selection and use.

6.4 MINIMUM ACCEPTABLE RESPIRATORY PROTECTION PROGRAM

An effective respiratory protective program requires close liaison among employees, supervisors, safety, industrial hygiene, and medical personnel to safeguard life and health through proper selection and use of respirators.

The proper respirator will be specified for each task with consideration given to both safety and health factors. Individuals issuing respirators will be adequately instructed to ensure that the correct respirator is issued and that each respirator is complete. Respirators will be assigned to the field employee on an as-needed basis.

Before initial use, each respirator will be properly fitted, leakage tests performed, and the facepiece-to-face seal tested. Before each use, both positive and negative pressure tests will be

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conducted. Respirators will not be worn when conditions such as a growth of beard, sideburns, a skull cap that projects under the facepiece, temple pieces on corrective spectacles or goggles, or the absence of one or both dentures prevent a good facepiece-to-face seal. Respirators will be regularly cleaned and disinfected. Those used by more than one worker will be thoroughly cleaned and disinfected after each use. Respirators will be stored in a convenient, clean, and sanitary location. This location must also be free of contaminants which might be absorbed by the cartridge or canister. Respirators used routinely will be inspected during cleaning. Experienced personnel will replace worn or deteriorated parts with parts designed for the respirator. No attempt will be made to replace components or to make adjustments or repairs beyond the manufacturer's recommendations. Reducing emission valves or regulators will be returned to the manufacturer or to a trained technician for adjustment or repair. Respirators for emergency use, such as self-contained devices, will be thoroughly inspected at least once a month and after each use, and a written record kept of inspection dates and findings. Workers should not be assigned to tasks requiring use of respirators unless it has been determined by a responsible physician that they are able to perform their work while wearing the prescribed respiratory protection. The medical status of the respirator user is reviewed annually.

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The use of supplied air will be restricted to compliance with the following:

- Cylinders will be tested and maintained as prescribed in the Shipping Container Specifications of the Department of Transportation (49 CFR 178).

- Breathing air for respirators may be supplied from cylinders or air compressors. It should meet at least the requirements of the specification for Grade D breathing air as defined in Compressed Gas Association Commodity specification G7.1-1966.

- The compressor for supplying breathing air will be equipped with necessary safety and standby devices as stated below. Compressors will be constructed and situated so as to avoid entry of contaminated air into the system. Suitable in-line air purifying sorbent beds and filters will be installed and maintained to further assure breathing air quality. An air storage receiver of sufficient capacity to enable the respirator wearer to escape from a contaminated atmosphere in the event of compressor failure, will be installed in the system. If an oil-lubricated compressor is used, it will have a high temperature or carbon monoxide alarm, or both. If only a high temperature alarm is used, the air for the compressor should be tested for carbon monoxide and oxygen at least monthly, or more frequently as indicated, to ensure that it meets air quality specifications.

- Air line couplings will be compatible with outlets for other gas systems to prevent inadvertent servicing of air line respirators with nonrespirable gases or oxygen.

- Breathing gas containers will be marked in accordance with American National Standards Institute, Standard Method of Marking Portable Compressed Gas Containers to Identify the Material Contained. Z48.1-1954 (R1971). ANSI 248.1-1954 (R1971).

6.4.1 SELECTION AND USE OF RESPIRATORY PROTECTIVE DEVICES

In the selection and use of respiratory protective devices, health and safety factors must be considered, such as nature of the hazard, intended uses and limitations of respiratory protective devices, movement and workrate limitations, emergency escape time and distance requirements, and training requirements. The human factor must also be considered since the effectiveness of the respiratory protective program can largely be determined by the degree of worker acceptance. Worker acceptance of respirators is influenced by comfort; ability to breathe without objectionable resistance; adequate visibility under all conditions; provisions for wearing prescription lenses if necessary; ability to communicate; ability to perform all tasks without undue interference; confidence in the facepiece fit; and convincing evidence that a respirator is necessary and that appropriate action is being taken, where possible, to eliminate the need for respiratory protective equipment.

Table 6-1, "Outline for Selecting Respiratory Protection Devices," and Table 6-2 "Protection Factors," will be considered during the selection process.

6.4.2 TRAINING, FACE FIT, AND LEAK TESTING

Personnel required to use, or to supervise personnel using, respiratory protective devices must be provided training as outlined.

Training

Unless the reasons for the use of respiratory protective devices and instructions on proper use and maintenance are thoroughly understood, and ongoing training provided, the devices will not be used or may not work properly. Minimum training should include:

- Instruction in the nature of the hazard, whether acute, chronic, or both and a frank appraisal of what may happen if the respirator is not used.

- Explanation of why more positive engineering or process-oriented controls are not immediately feasible to reduce or eliminate the need for respirators.

- A discussion of why this is the proper type of respirator for the particular purpose.

- A discussion of the respirator's capabilities and limitations.

- Periodic instruction and training in actual use of the respirator. Training should also include recognition of the end of the service life of cartridges/canisters or filter (e.g., smelling organic vapors through the cartridges/canisters manufacturer specified termination date, or an increase in breathing resistance).

- Classroom and field training to recognize and cope with emergency situations.

- Detailed instructions on cleaning and maintenance of the respirator.

Face fit and Leak testing

Respirators are generally uncomfortable to wear. If a good facepiece-to-face seal can be obtained only by very tight strap tension, the respirator will not be worn for prolonged periods and its use will be avoided. Even though maximum breathing resistance is specified by NIOSH there are differences among approved respirators and one type may be more acceptable to the worker than another. Facial structure varies considerably from one individual to another, and since a given respirator is usually made in only one size, a successful fit cannot always be achieved for all persons. Different sizes of the same model or different models of approved respirators may have to be obtained to provide an adequate fit for employees.

Proper fitting of respiratory protective devices for individuals wearing corrective spectacles or goggles is a problem. A proper seal cannot be established if the temple bars or straps extend through the sealing edge of the facepiece. Systems or kits for mounting corrective lenses inside full facepieces can be purchased with the facepiece. When an employee must wear corrective lenses as part of the facepiece, the facepiece and lenses will be fitted by qualified individuals to provide good vision, comfort, and a gas-tight seal.

The test is conducted according to the following procedures:

- The wearer puts on the respirator, taking care not to tighten the headstraps uncomfortably.
- The person is placed in front of ventilation hood.
- The tester informs the wearer to close the eyes.
- The tester lightly puffs smoke over the respirator holding the tube at least 2 feet from it. The tester should keep the smoke minimal and pause between puffs to note the wearer's reaction.
- If no leakage is detected the tester may increase the smoke density and move the smoke tube progressively closer to the subject, still remaining alert to any reactions.
- When smoke has been brought to within about 6 inches with no detectable leakage, the tester may start to direct smoke specifically at the potential sources of leakage, around the sealing surface and exhalation valve, while the subject holds the head still.
- With still no detectable leakage the wearer cautiously begins head movement. The tester should remain alert and prepared to stop smoke generation immediately.
- Any detection of leakage should stop the test. Subject should readjust respirator and begin at procedure 2.

A Respirator Training Form as appears in Figure 6-1 is completed to document respirator training and fit testing.

6.4.3 MAINTENANCE AND CARE OF RESPIRATORS

When respirators are issued to individuals, the individual is responsible for primary maintenance and care of the respirator. Where respirators are used collectively or kept ready for emergencies by an operating activity, respirator maintenance and cleaning programs must be established. This program would be adjusted for the number of types of respirators in use, working conditions and hazards involved, and will include the following basic services: inspection for defects (including a leak check), cleaning and disinfecting, repair, and storage.

All respirators will be inspected routinely before and after each use. A respirator that is not routinely used but kept ready for emergency use will be inspected after each use and at least monthly to assure that it is in satisfactory working condition.

Self-contained breathing units will be inspected monthly. Air cylinders will be inspected monthly. Air cylinders will be fully charged according to the manufacturer's instructions. It will be determined that the regulator and warning devices function properly.

Respirator inspection will include a check of the tightness of connections and the condition of the facepiece, headbands, valves, connecting tube, and canisters. Rubber or elastomer parts will be inspected for pliability and signs of deterioration. Stretching and manipulating rubber or elastomer parts with a massaging action will keep them pliable and flexible and prevent them from hardening during storage.

Respirators issued to specific individuals will be cleaned and disinfected as frequently as necessary to ensure that skin penetrating and dermatitis causing contaminants are removed from respirator surfaces. Respirators maintained for emergency use or used by more than one person will be cleaned and disinfected after each use.

6.4.4 CLEANING AND DISINFECTING

The following procedures are recommended for cleaning and disinfecting respirators:

- Remove any filters, cartridges, or canisters.
- Wash facepiece and breathing tube in a cleansing disinfectant solution. A brush may be used to facilitate dirt removal.
- Rinse completely in clean, warm water.
- Air dry in a clean area.
- Clean other respirator parts as recommended by the manufacturer.

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- Inspect valves, headstraps, and other parts; replace defective parts with new ones.

- Inspect new filters, cartridges, or canisters periodically as specified by the manufacturer; make sure seal is tight.

- Place in plastic bag or other closed container for storage.

Cleaner disinfectant solutions may be commercially prepared which are followed by a clean, warm water rinse and air dried; or respirators may be washed in a liquid detergent solution, then dipped in a disinfectant solution, rinsed, and air dried.

Replacement or repair will be done only by experienced persons using parts designed for the respirator. No attempt will be made to replace components or to make adjustments or repairs beyond the manufacturer's recommendations. Reduction or admission valves or regulators will be returned to the manufacturer or to a trained technician for adjustment or repair.

Respirator storage will be as follows:

After inspection, cleaning, and necessary repair respirators will be stored to protect against dust, sunlight, heat, extreme cold, excessive moisture, or damaging chemicals. Respirators placed at stations and work areas for emergency use should be stored in compartments built for the purpose, clearly marked to indicate the content, and must be quickly accessible at all times. Routinely used respirators, such as dust respirators, may be placed in plastic bags. Respirators should not be stored in such places as lockers or tool boxes unless they are in containers or cartons.

Respirators should be packed or stored so the facepiece and exhalation valve will rest in a normal position and function will not be impaired by the elastomer setting in an abnormal position.

Instructions for proper storage of emergency respirators, such as gas masks and self-contained breathing apparatus, are found in "use and care" instructions usually mounted inside the carrying case lid.

6.4.5 RESPONSIBILITY FOR RESPIRATORY PROTECTION PROGRAM

The Corporate Manager of Health and Safety Programs will be ultimately responsible for specifying respiratory protective devices.

6.5 SPECIFICATION FOR BREATHING AIR

Grade D Type I is the minimum grade for routine use in self-contained or supplied-air protective breathing equipment as used in industry, fire fighting, or general respiratory use (same as ANSI Z 86.1-1973).

Note 1: The term "atm" denotes the oxygen content normally present in the atmospheric air; the numerical values denote the oxygen limits for synthesized air.

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Note 2: The water content of compressed air required for any particular grade may vary with the intended use from saturated to very dry. If a specific water limit is required, it should be specified as a limiting dewpoint or concentration in ppm (v/v). Dewpoint is expressed in temperature at one atmosphere absolute pressure (760 mm Hg). For use at temperatures below freezing, excess water content should be reduced.

Note 3: Specific measurement for odor in type I air is impractical. Air normally may have a slight odor. The presence of a pronounced odor should render the air unsatisfactory for breathing purposes.

For uses other than the above, consult the reference in its entirety to determine the proper grade to be specified.

6.6 DESCRIPTION AND LIMITATIONS OF RESPIRATORY PROTECTION DEVICES (Extracted from 30 CFR 11)

6.6.1 AIR PURIFYING RESPIRATORS

General Description: Half-mask, full facepiece, or mouthpiece respirator equipped with air purifying units to remove gases, vapor, and particulate matter form the ambient air prior to its inhalation. Some air purifying respirators are blower-operated and provide respirable air to the facepiece (or hood) under a slight positive pressure.

General Limitations: Air-purifying respirators do not protect against oxygen-deficient atmospheres nor against skin irritation by, or absorption through the skin of, airborne contaminants. The maximum contaminant concentration against which an air-purifying respirator will protect is determined by the designed efficiency and capacity of the cartridge, canister, or filter for the contaminant. The maximum concentration for which the air-purifying unit is effective is specified below or by applicable federal occupational health standards. Respirators will not provide the maximum design protection specified unless the facepiece is carefully fitted to the wearer's face to prevent inward leakage. The time period over which protection is provided is dependent on canister, cartridge, or filter type; concentration of contaminant; and the wearer's respiratory rate. The proper type of canister, cartridge, or filter must be selected for the particular atmosphere and conditions. Air-purifying respirators may cause discomfort and objectionable resistance to breathing. Respirator facepieces present special problems to individuals required to wear prescription lenses.

6.6.2 GAS AND VAPOR - REMOVING RESPIRATORS

General Description: Packed sorbent beds (cartridge or canister) remove single gases or vapors (i.e., chlorine gas), a single class of gases or vapors (i.e., organic vapors), or a combination of two or more classes of gases and vapors (i.e., acid gases, organic vapors, ammonia, and carbon monoxide) by absorption, chemical reaction or catalysts, or a combination of these methods.

Maximum use concentrations are lower for organic vapors which produce atmospheres immediately hazardous to life or health at concentrations equal to or lower than this concentration.

Half-mask facepiece - no protection is provided for the eyes. Fabric coverings of the facepiece will not be used since it will permit gases and vapors to leak into the mask.

6.6.5 DUST, FUME, AND MIST RESPIRATORS

General Description: Includes all completely assembled respirators designed for use as respiratory protection during entry into and escape from hazardous particulate atmospheres which contain adequate oxygen to support life. Devices may be attached to a powered blower. Each device may contain the following component parts: facepiece (half-mask or full); hood, helmet: filter unit, harness, attached blower, and breathing tube. These devices are further described as follows:

- Respirators, either with replaceable or reusable filters, designed as respiratory protection against dusts, fumes, and mists having maximum acceptable exposure limit not less than 0.05 milligrams per cubic meter (mg/m) of air.

- Respirators with replaceable filters designed as respiratory protection against dust, fumes, and mists having maximum acceptable exposure limits less than 0.05 mg/m^3.

- Respirators with replaceable filters designed as respiratory protection against radon daughters, and radon daughters attached to dusts, fumes, and mists.

- Respirators with replaceable filters designed as respiratory protection against asbestos-containing dusts and mists.

- Single-use dust respirators designed for protection against pneumoconiosis and fibrous producing dusts, or dusts and mists, including asbestos.

General Limitations: Protect against nonvolatile particulates only. No protection against gases and vapors. The filter will be replaced or cleaned when breathing becomes difficult due to plugging by retained particles. These respirators will not be used during shot and sand blasting operations.

Half-Mask Facepieces - Fabric coverings are only permissible in atmospheres of coarse dusts and mists of low toxicity. No protection is provided to the eyes.

6.6.6 COMBINATION GAS, VAPOR, AND PARTICULATE REMOVING RESPIRATORS

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General Description: Includes all the devices discussed having either canisters or cartridges with filters for protection against dusts, mists, fumes, gases, and vapors. These include respirators which have been tested against lacquers and enamel mists (paint spray respirators).

General Limitations: With the exception that these devices protect against both gases and vapors and particulates, the limitations of the other devices would also apply to the combination device.

6.6.7 PESTICIDE RESPIRATOR

General Description: Includes all completely assembled respirators which are designed for use as respiratory protection during entry into and escape from atmospheres containing pesticide hazards. These would include the following types:

- Front- or back-mounted gas masks
- Chin style gas masks
- Chemical cartridge respirator
- Air-purifying respirator with attached blower combination devices.

General Limitations: Limitations previously discussed for each type of device will also apply, in general, to pesticide respirators.

6.7 ATMOSPHERE-SUPPLYING RESPIRATORS

General Description: A respirable atmosphere is supplied independent of the ambient air surrounding the wearer. These devices provide protection against oxygen deficiency and most toxic atmospheres.

General Limitations: Except for the supplied air suit, no protection is provided against skin irritation by materials such as Ammonia and Hydrochloric Acid (HCl), or against absorption of materials such as Hydrocyanic Acid (HCN), tritium, or organic phosphate pesticides through the skin. Facepieces present special problems to individuals required to wear prescription lenses.

6.7.1 SELF-CONTAINED BREATHING APPARATUS

General Description: Includes all completely assembled, portable, self-contained devices designed for use as respiratory protection during entry into and escape from hazardous atmospheres.

Closed-circuit Apparatus - An apparatus of the type in which the exhalation is rebreathed by the wearer after the carbon dioxide has been effectively removed and a suitable oxygen concentration restored from sources composed of compressed, chemical, or liquid oxygen.

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Open-circuit Apparatus - An apparatus of the following types from which exhalation is vented to the atmosphere and not rebreathed.

Demand-type Apparatus - An apparatus in which the pressure inside the facepiece in relation to the immediate environment is positive during exhalation and negative during inhalation.

Pressure-demand Type Apparatus - An apparatus in which the pressure inside the facepiece in relation to the immediate environment is positive during both inhalation and exhalation.

General Limitations: Use is permissible in atmospheres immediately dangerous to life or health. The period over which the device will provide protection is limited by the amount of air or oxygen in the apparatus.

Closed-circuit apparatus - The closed circuit operation conserves oxygen and permits longer service life.

Open-circuit demand and pressure demand - The demand type produces a negative pressure in the facepiece on inhalation whereas the pressure-demand type maintains a positive pressure in the facepiece and is less apt to permit inward leakage of contaminants.

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6.7.2 SUPPLIED AIR RESPIRATORS

General Description: Includes all completely assembled respirators designed for use during entry into or escape from hazardous atmospheres. The respirable air supply is not limited to the quantity an individual can carry; these devices are lightweight and relatively simple.

Type "A" supplied air respirator - A hose mask respirator for entry into and escape from hazardous atmospheres, which consists of a motor driven or hand operated blower that permits the free entrance of air when the blower is not operating; a strong, large diameter hose having a low resistance to airflow; a harness to which the hose and the lifeline are attached; and a tight fitting facepiece.

Type "B" supplied air respirator - A hose mask respirator for entry into and escape from atmospheres not immediately dangerous to life or health which consists of a strong, large diameter hose with low resistance to airflow; a harness to which the hose is attached; and a tight fitting facepiece.

Type "C" supplied air respirator - An airline respirator for entry into and escape from atmospheres not immediately dangerous to life or health which consists of a source or respirable breathing air, hose, detachable coupling, control valve, orifice, demand valve or pressure-demand valve, and arrangement for attaching the hose to the wearer; and a facepiece, hood, or helmet.

Types "AE", "BE", and "CE" supplied air respirators - Types "A," "B," or "C" supplied air respirator equipped with additional devices designed to protect the wearer's head and neck against impact and abrasion, and with shielding material to protect the window(s) of facepieces,

hoods, and helmets which do not unduly interfere with the wearer's vision and permit easy access to the external surface of such window(s) for cleaning.

General Limitations: The wearer is restricted in movement by the hose or airline and must return to a respirable atmosphere by retracing his route of entry. The hose or airline is subject to being severed or pinched off.

Type "A" hose mask respirator with blower - If the blower fails, the units still provide an air supply and sufficient protection to permit the wearer to escape although a negative pressure exists in the facepiece during inhalation. Use is permissible in atmospheres immediately dangerous to life or health.

Type "B" hose mask without blower - If the air supply fails, no protection is provided the wearer. Limited to use in atmospheres not immediately dangerous to life or health and from which the wearer can escape unharmed without aid of the respirator.

Type "C" airline respirators (continue flow, demand, and pressure-demand types) - The demand type produces a negative pressure in the facepiece on inhalation whereas continuous flow and pressure demand types maintain a positive pressure in the facepiece at all times and are less apt to permit inward leakage of contaminants. Demand flow airline respirators are limited to use in atmospheres immediately dangerous to life or health provided an auxiliary self-contained air supply is worn to permit escape if the air supply fails.

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SECTION 13

TEMPERATURE EXTREMES

13.1 Introduction

A majority of CDM Federal project activities are performed in outdoor locations and, as such, employees occasionally perform these activities in elevated and depressed temperatures extremes. In light of this, it's important that all employees understand the signs and symptoms of potential injuries associated with working in temperature extremes.

13.2 Heat Stress

Heat stress occurs when the body's physiological processes fail to maintain a normal body temperature because of excessive heat. The body reacts to stress related to heat a number of different ways. The reactions range from mild, such as, fatigue, irritability, anxiety, and decreased concentration, to severe, such as death. Heat related disorders are generally classified into four basic categories: heat rash, heat cramps, heat exhaustion, and heat stroke. The descriptions, symptoms, and treatment for these diseases are described as follows.

Heat Rash

Description - Heat rash is caused by continuous exposure to heat and humid air and is generally aggravated by coarse clothing. This condition decreases the ability to tolerate heat. This condition is the mildest of heat related disorders.

Symptoms - Mild red rash which is generally more prominent in areas of the body in contact with personal protective equipment.

Treatment - Decrease the amount of time in personal protective equipment and use powder to help absorb moisture.

Heat Cramps

Description - Heat cramps are caused by perspiration that is not off-set with adequate fluid intake. This condition is the first sign of a situation that can lead to heat stroke.

Symptoms - Acute, painful spasms occurring in the voluntary muscles (e.g., abdomen and extremities).

Treatment - Remove victim to a cool area and loosen clothing. Have victim drink 1-2 cups of water immediately and every 20 minutes thereafter until the symptoms subside. Total water consumption should be 1-2 gallons per day. Consult with a physician.

Heat Exhaustion

Description - Heat exhaustion is a state of very definite weakness or exhaustion caused by the loss of fluids from the body. This condition is more severe than heat cramps.

Symptoms - Pale, clammy, moist skin with profuse perspiration and extreme weakness. Body temperature is generally normal and the pulse is weak and rapid. Breathing is shallow. The victim may show signs of dizziness and may vomit.

Treatment _ Remove the victim to a cool, air conditioned atmosphere. Loosen clothing and require that the victim lay in a flat position with the feet slightly elevated. Have the victim drink 1-2 cups of water immediately and every 20 minutes until the symptoms subside. Seek medical attention, particularly in severe situations.

Heat Stroke

Description - Heat stroke is an acute and dangerous situation. It can happen in a very short time period. The victims temperature control system shuts down completely resulting in a rise in body core temperature to levels that can cause brain damage and can be fatal if not treated promptly and effectively.

Symptoms - Red, hot, dry skin, with no perspiring. Rapid respiration, high pulse rate, and extremely high body temperature are other symptoms.

Treatment - Cool the victim quickly. If the body temperature is not brought down fast, permanent brain damage or death can result. The victim should be soaked in cool water. Get medical attention as soon as possible.

13.2.1 Preventive Measures

There are a number of steps that can be taken to minimize and/or eliminate the potential for heat stress disorders when working in hot atmospheres. Some of these are as follows:

* Acclimate employees to working conditions by slowly increasing workloads over extended periods of time. Do not begin site work activities with the most demanding physical expenditures.

* Where possible, conduct strenuous activities during cooler portions of the day, such as, early morning or early evening.

* Provide and encourage all employees to drink lots of tempered water during the course of the work shift and discourage the use of alcohol during nonworking hours. It's essential that fluids lost due to perspiration get replenished.

* During hot periods, rotate employees wearing impervious clothing.

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* Provide cooling devises when appropriate. Mobile showers and/or hose down facilities, powered air purifying respirators, and ice vests have all proven effective in reducing heat stress potential.

13.2.2 Heat Stress Monitoring

For strenuous field activities that are part of on-going site work activities in hot weather, the following procedures are used to monitor the body's physiological response to heat. These procedures are implemented when employees are required to wear impervious clothing in atmospheres exceeding 70°F.

* Monitor Heart Rate (HR) - Heart rate should be measured by the radial pulse for 30 seconds as early as possible in the resting period. The measurement at the beginning of the rest period should not exceed 110 beats/minute. If the heart rate is in excess, the next work period should be shortened by 33%, with the length of the rest period remaining the same. If the heart rate is still in excess at the beginning of the next rest period, the following work cycle should be shortened by 33%. This procedure continues until the rate is maintained below 110 beats/minute.

* Monitor Body Temperature - Body temperature is measured orally with a clinical thermometer as early as possible in the resting period. Temperatures should not exceed 99.6°F. If it does, the next work period should be shortened by 33%. If the oral temperature at the end of the next work period still exceeds 99.6°F, the following work cycle is shortened by another 33%. This procedure continues until the body temperature is maintained below 99.6°F.

The following work/rest schedules are provided as a guideline when working in Level B or Level C personal protective equipment:

ADJUSTED TEMPERATURE (°F)*	WORK SCHEDULE (MIN/HR)
75	50
80	40
85	30
90	20
95	10
100	0

* Adjusted temperature is the sum of the actual temperature plus the product of 13 times the fraction of sunshine. The fraction of sunshine is an estimate of what percent of the time that the sun is not clouded, i.e., 100% sunshine=no cloud cover=1.0, 0% sunshine=full cloud cover=0.0, etc.

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13.3 Cold Stress

Persons working outdoors in low temperatures, especially at or below freezing, are subject to cold stress disorders. Exposure to extreme cold for even a short period of time can cause severe injury to the body surfaces and/or profound cooling which can lead to death. Areas of the body that have high surface area-to-volume ratios, such as, fingers, toes, and ears, are the most susceptible.

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ATTACHMENT B

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ATTACHMENT C

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CONTROL OF MEASUREMENT AND TEST EQUIPMENT

SOP 5-1
Revision: 1
Date: November 1, 1993

Prepared: 10/29/93 Signature/Date
Technical Review: 10/29/93 Signature/Date
QA Review: 10/29/93 Signature/Date
Approved: 10/29/93 Signature/Date
Issued: 11/1/93 Signature/Date

1.0 OBJECTIVE

The objective of this standard operating procedure is to establish the baseline requirements, procedures and responsibilities inherent to the control and use of all measurement and test equipment.

2.0 BACKGROUND

2.1 Discussion

To ensure the accuracy of M&T results, M&TE purchased for CDM Federal corporate use and government furnished M&TE purchased or acquired through transfer, must be utilized in full compliance with the requirements for:

- Preparing and attaching Equipment Procedures and Equipment Logs
- Shipment
- Record keeping
- The traceability of calibration standards
- Removing an item of M&TE from use if it cannot be calibrated or adjusted to perform accurately

M&TE leased or rented through outside vendors must be utilized in full compliance with the requirements stated above with the exception that Equipment Procedures and Equipment Logs will not be prepared or attached. Rented or leased M&TE must be used in accordance with the manufacturer's operating, maintenance and calibration procedures.

2.2 Definitions

EC - Equipment Coordinator

EL - Equipment Log

EP - Equipment Procedure

ESCM - Equipment Service Center Manager

EWM - Equipment Warehouse Manager

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Field Check - The reading obtained prior to and after actual use in the field.

M&TE - Measurement and test equipment

M&T - Measurement and testing

M&C - Maintenance and calibration

Traceability - The ability to trace the history, application, or location of an item and like items or activities by means of recorded identification.

2.3 Associated Procedures

- CDM Federal Equipment Procedures (EPs)
- Manufacturer's operating, maintenance and calibration procedures

3.0 RESPONSIBILITIES

All staff with responsibility for the control of M&TE and all users of M&TE are responsible for implementing the requirements contained herein.

3.1 M&TE Users Responsibilities

- Follow the EPs when using CDM Federal corporate M&TE and government furnished M&TE
- Specify that the manufacturer's operating, maintenance and calibration procedures are included when renting or leasing M&TE from outside vendors and follow those procedures during M&TE use
- Use calibration standards traceable to nationally recognized standards.
- Ensure that measurements are valid by checking post run calibration or field checks
- Make proper entries into the Equipment Log and document the calibration, use and service of the equipment
- Make proper entries into the Field Log as specified in the project-specific controlling documents
- Make photocopies of the Equipment Log pages and send them to the ESCM, EWM or EC as appropriate

3.2 ESCM Responsibilities

With the exception of M&TE rented or leased from outside vendors, the ESCM shall obtain the manufacturer's operating, maintenance and calibration procedures and prepare and attach, or direct the attachment of, Equipment Procedures and Equipment Logs to M&TE shipping cases. For M&TE for which the ESCM is directly responsible, the ESCM shall also:

- Label items of M&TE requiring calibration
- Affix a calibration label on M&TE calibrated by them
- Ensure that M&TE is maintained as required
- Ensure that M&TE is calibrated to standards traceable to nationally recognized standards

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- Consume or dispose of standards on or before the expiration date
- Maintain M&TE records
- Periodically review M&TE records and report all non-conforming items and take appropriate corrective action as required

3.3 EWM and EC Responsibilities

For M&TE for which the EWM and EC are directly responsible, the EWM and the EC shall:

- Label items of M&TE requiring calibration
- Affix a calibration label on M&TE calibrated by them
- Maintain M&TE records
- Ensure that M&TE is maintained as required
- Ensure that M&TE is calibrated to standards traceable to nationally recognized standards
- Consume or dispose of standards on or before the expiration date
- Periodically review M&TE records and report all non-conforming items and take appropriate corrective action as required

4.0 REQUIREMENTS

With the exception of M&TE rented from outside vendors, M&TE shall not be used unless an Equipment Procedure and an Equipment Log have been established and attached to the shipping case of the item. M&TE rented or leased from outside vendors shall be operated, maintained and calibrated in accordance with the manufacturer's procedures. Calibration status shall be identified on M&TE.

4.1 Prepare and Attach an Equipment Procedure

With the exception of M&TE rented or lease from outside vendors, each M&T instrument shall have an EP. Some or all of the following information, as appropriate to the M&TE, will be included:

- Applications
- Calibration standards
- Calibration frequency
- Initial calibration tolerance
- Post run calibration tolerance
- Calibrated instrument range
- Field check frequency
- Field check acceptance range
- Maintenance frequency
- Measurement type
- Safety considerations
- Limitations of use
- Interferences
- Start-up procedure
- Operating procedure

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- Shutdown procedure
- Field check procedure
- Field calibration procedure
- Field maintenance procedure
- ESC calibration procedure
- ESC maintenance procedure

The EP provides the instrument-specific information to ensure that the M&TE is calibrated, used and maintained according to the proper written procedure.

4.2 Prepare and Attach an Equipment Log

With the exception of M&TE rented or leased from outside vendors, each M&T instrument must have an EL. The following items will be entered into the EL each time the equipment is serviced or calibrated:

- The date
- The time of the entry
- The name of the item of M&TE
- The serial number and Property Control Number (if applicable) of the item of M&TE
- The name of the person making the entries
- The project number
- The description of activity (or project)
- The calibration standard used
- The concentration of the calibration standard
- The lot number of the calibration standard
- The expiration of the calibration standard
- The pre-calibration reading obtained on the calibration standard
- The reading obtained on the standard after the calibration or maintenance is performed
- Any notable incidents that may contribute to the proper calibration, repair or decontamination of the instrument
- The date and signature of the person making the entries after the final entry.

The EL provides documentation that the M&TE was calibrated and/or field checked in accordance with the EP. When M&TE that is rented or leased from outside vendors is serviced or calibrated, that information will be recorded in the Field Log as specified in the project-specific controlling documents.

4.3 Label M&TE Requiring Calibration

Items of M&TE that require calibration, immediately before use shall have a label affixed to them stating "Calibrate Before Use." M&TE that is calibrated at scheduled intervals shall have a calibration label attached listing the date of the calibration, date the M&TE is next due for calibration and the initials of the person performing the calibration.

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4.4 Shipment

With the exception of M&TE rented or leased from outside vendors, M&TE shall be shipped with the CDM Federal Equipment Procedure and the Equipment Log. M&TE rented or leased from outside vendors shall be shipped with the manufacturer's standard operating, maintenance and calibration procedures.

4.5 Record Keeping

With the exception of M&TE rented or leased from outside vendors, every item of M&TE shall have a complete "cradle to grave" record established and maintained. By category, the following records are to be included in each respective M&TE item file:

Operating Instructions: manufacturer's operating manual and the CDM Federal EP.

Maintenance and Calibration: all maintenance and calibration records; Equipment Log records; certifications of standards; and the receipt and expiration date of standards.

Reporting: project or service center correspondence; inventory reports; missing stolen or damage reports; excess equipment reports; non-hazardous certification (for government owned property); disposal reports; transfer reports; utilization reports; and non-conformance reports

Shipping: packing slips; air freight or other transportation shipping; and receipt documents

Miscellaneous or Invoicing: any document regarding the equipment that does not readily fit in a defined category and/or invoices for the rental of M&TE assigned to the Equipment Service Center

4.6 Traceability of Calibration Standards

M&TE requires calibration that is ultimately traceable to nationally recognized standards. This calibration may be performed by CDM Federal personnel following the calibration procedure specified in the EPs or the M&TE can be calibrated by an appropriately qualified outside source. If calibration is performed by CDM Federal, the standards used must be appropriate for the M&TE application and must be traceable to nationally recognized standards. Calibration performed by outside sources must include documentation of traceability to nationally recognized standards.

5.0 PROCEDURES

5.1 Prepare and Attach an Equipment Procedure and an Equipment Log

The following procedures must be followed whenever M&TE is purchased or received through transfer:

1. Upon the initial receipt of M&TE the recipient shall immediately notify the ESCM via telephone, EMAIL, facsimile or hard copy memorandum.

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2. The ESCM will obtain the appropriate manufacturer's operating manual and/or instructions.

3. The ESCM will prepare an EP, obtain appropriate approvals, and attach or forward the EP to the recipient directing that the procedure be attached to the shipping case.

4. The ESCM will prepare an EL, and attach or forward the EL to the recipient directing that it be attached to the shipping case.

5.2 Shipment

The following procedures are to be followed whenever M&TE is shipped:

1. With the exception of M&TE rented or leased from outside vendors, the ESCM, EWM, or EC should inspect the shipping case to ensure that the operating documentation as specified in the CDM Federal EP and the EL, is complete and included with the shipment.

2. For M&TE that is rented or leased from outside vendors, the CDM Federal staff member responsible for effecting the shipments should specify to the outside vendor that the manufacturer's operating, maintenance and calibration procedures be included with the shipment.

3. If the documents are complete and included, proceed to ship the equipment.

4. If a required document is missing or incomplete, do not ship the equipment. Immediately contact the ESCM via telephone, EMAIL, facsimile or hard copy memorandum and request new operating procedures and/or an EL.

5. If the EL is incomplete immediately contact the ESCM via telephone, EMAIL,facsimile or hard copy memorandum. The ESCM will take appropriate corrective action.

5.3 Record Keeping

The following steps must be followed when establishing and maintaining an equipment file:

1. Upon the initial receipt of M&TE through purchase or transfer create a permanent equipment file.

2. Maintain the files by item of M&TE and keep all files in a cabinet or drawer at the pertinent warehouse or office location, segregated by contract or service center origin.

3. With the exception of the Equipment Log and the manufacturers packing slip, all original documents will be included in the equipment file upon receipt.

4. Upon receipt of M&TE, the recipient shall photocopy the packing slip. The recipient shall forward the original packing slip to Accounts Payable. The recipient shall forward the photocopy to the ESCM, the EWM or the EC, whomever of these individuals is the responsible party for the item of M&TE, for inclusion in the equipment file

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5. On a weekly basis the user of M&TE shall photocopy the pages of the Equipment Log for that week of activities and forward them to the ESCM, the EWM, or the EC, whichever of those individuals is the responsible party for the item of M&TE.

5.4 Traceability of Calibration Standards

The following steps must be taken to ensure the traceability of calibration standards:

1. Calibration standards will be procured requiring certification to a nationally recognized standard.

2. Certifications of standards will be maintained in the equipment files.

3. Standards that are perishable will be noted on a schedule and consumed or disposed of on or before the expiration date.

5.5 M&TE That Fails Calibration

The following steps must be followed if an item of M&TE cannot be calibrated or adjusted to perform accurately:

1. At each instance of M&C, check the results to make sure they are within the limits specified in the manufacturer's maintenance and calibration documentation and/or the CDM Federal Equipment Procedure as appropriate.

2. If an item fails a calibration procedure the operator shall immediately notify the Project Manager for the project on which the item is being used as well as the ESCM, EWM, or EC responsible for that item of M&TE. Discontinue using the equipment until it is restored to full working order and re-calibrated.

3. The operator or person who determines an item has failed a calibration, shall report the item as a non-conforming item and take appropriate action in accordance with the quality procedure for non-conforming items in the CDM Federal Programs Corporation Quality Assurance Manual.

4. The ESCM shall review the current and previous M&C records to determine if the validity of previous M&T results could have been affected and shall notify the appropriate project manager(s) if a potential negative impact is determined.

5. The ESCM shall review the current and previous M&C records annually, or more frequently if required, to determine if problematic trends are evident. If problematic trends are evident the ESCM shall take appropriate action to mitigate the trend and shall remove the item of M&TE from service until that item of M&TE is fully operational and the problematic trend has been cured.

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6.0 RESTRICTIONS/LIMITATIONS

On an item by item basis, exemptions from the requirements of this Standard Operating Procedure may be granted by the Headquarters Administrative manager with the concurrence of appropriate Headquarters Health and Safety and/or Quality Assurance staff. All exemptions from this Standard Operating Procedure shall be documented by the Headquarters Administrative Manager and included in the equipment records.

7.0 REFERENCES

- CDM Federal Programs Corporation Quality Assurance Manual
- CDM Federal Programs Corporation Property Control Manual
- CDM Federal Programs Corporation Technical Standard Operating Procedures.

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Appendix C

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APPENDIX C

LABORATORY ANALYTICAL RESULTS FROM PREVIOUS INVESTIGATIONS

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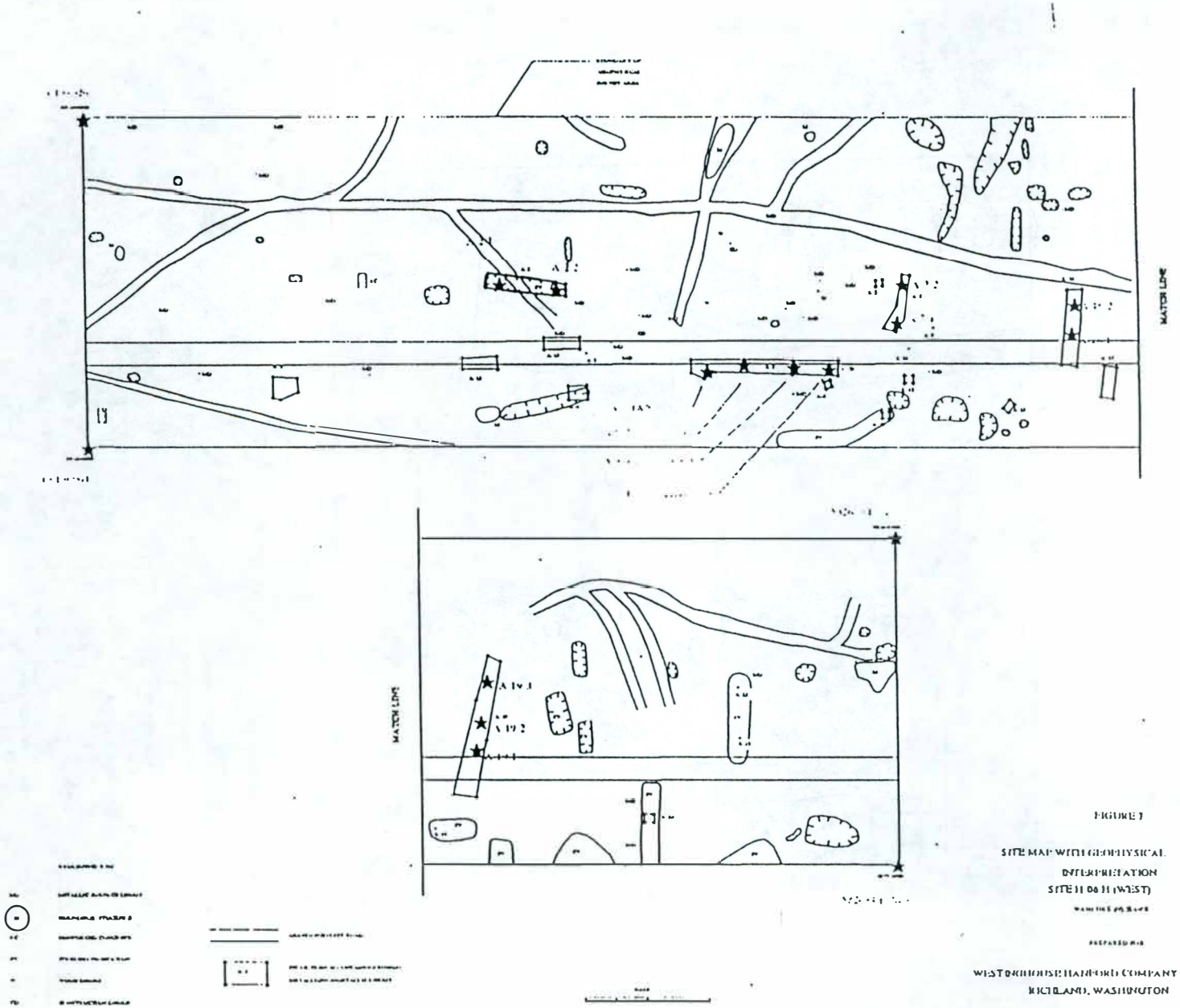
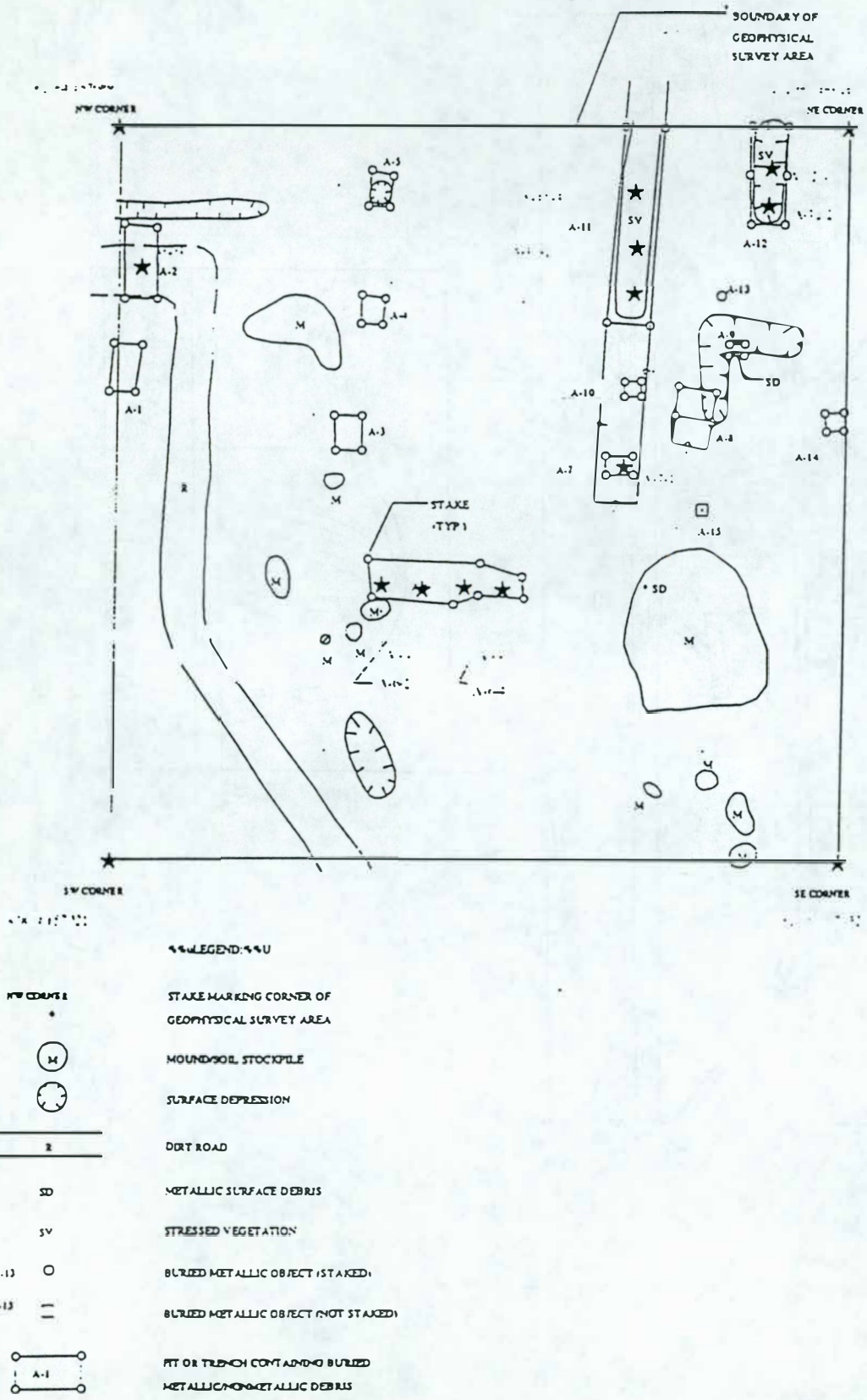


Figure 2-1f. Site Map with Geophysical Interpretation Site H-06-H (West) Wahluke Slope.

Figure 2-1e. Site Map with Geophysical Interpretation
Site H-06-H (East) Wahluke Slope.



SAMPLE NUMBER	B07GM0	B07GM1	B07GM2	B07GM3	B07GM4	B07GM6
LOCATION	H-63-L/A-2-2	H-63-L/A-2-3	H-63-L/A-1-3	H-63-L/A-3-2	H-63-L/A-3-3	H-63-L/A-4-1
COMMENTS	9-11 ft, SW-846	9-11 ft, CLP	9-11 ft, SW-846	9-11 ft, CLP	9-11 ft, SW-846	9-11 ft, SW-846
BENZ-VOA (ug/kg)						
di-n-butylphthalate	140 JB	U	U	U	U	U
diethyl phthalate	U	U	U	U	U	U
phenanthrene	U	U	U	U	U	U
fluoranthene	U	U	U	U	U	U
pyrene	U	U	U	U	U	U
benzo(a)anthracene	U	U	U	U	U	U
chrysene	U	U	U	U	U	U
benzo(b)fluoranthene	U	U	U	U	U	U
benzo(k)fluoranthene	U	U	U	U	U	U
benzo(a)pyrene	U	U	U	U	U	U
bis(2-ethylhexyl)phthalate		U	U	U	U	U
indeno(1,2,3-cd)pyrene	U	U	U	U	U	U
dibenzo(a,h)anthracene	U	U	U	U	U	U
benzo(g,h,i)perylene	U	U	U	U	U	U
VOA (ug/kg)						
acetone	U	5 BJ	3.8	5 BJ	4.3	5.8
2-hexanone	0.8	U	3.8	U	U	U
methylene chloride	U	U	U	U	U	U
toluene	U	U	U	U	U	U
methyl-pentanone	U	U	U	U	U	U
ICP METALS (ug/kg)						
Al	7300	7000	7700	6510	9000	8000
Sb	U	U N	U	U N	U	U
Ba	67	70.2	77	119 E	100	88
Be	U	U	U	U	U	U
Cd	U	U	U	U	U	U
Ca	9000	9000	9400	8670	11000	11000
Cr	12	12	13	11	14	13
Co	6	5.2 B	7	5.1 B	8	7
Cu	9	21.2 *	13	11 *	12	12
Fe	14000	14500	20000	14500	20000	18000
Li	10	NA	10	NA	12	11
Mg	5200	5000	6600	4600	6100	5700
Mn	270	273	350	283	370	340
Mo	U	NA	U	NA	U	U
Ni	11	11.2	12	11.8	14	11
P	400	NA	670	NA	650	530
K	1400	1330	1700	1420	1800	1700
Ag	U	U	U	U NW	U	U
Na	170	245 B	160	200 B	240	100
Sr	37	NA	32	NA	47	38
V	26	26.5	32	26.2	43	35
Zn	35	37.4	46	48.2	45	42
Hg		0.008		0.05 B		
As		3.3		3.3		
Pb		5.5 N*		9.2 N*		
Se		U NW		U		
Tl		U		U		
AA METALS (ug/kg)						
As	2.9		4.7		3.3	3.6
Pb	5.8		22		4.8	5.2
Se	U		U		U	U
Tl	U		U		U	U
MERCURY (ug/kg)	U	0.06 B	U	0.05 B	U	U

SAMPLE NUMBER	B07GM0	B07GM1	B07GM2	B07GM3	B07GM4	B07GM5
LOCATION	H-83-UA-2-2	H-83-UA-2-3	H-83-UA-1-3	H-83-UA-3-2	H-83-UA-3-3	H-83-UA-4-1
COMMENTS	9-11 ft, SW-846	9-11 ft, CLP	9-11 ft, SW-846	9-11 ft, CLP	9-11 ft, SW-846	9-11 ft, SW-846
HERBICIDES (ug/kg)						
2,4-D	U	U	U	U	U	U
2,4-DB	U	U	U	U	U	U
2,4,5-T	U	U	U	U	TBA	TBA
2,4,5-TP	U	U	U	U	U	U
Dalapon	U	U	U	U	U	U
Dicamba	U	U	U	U	U	U
Dichlorprop	U	U	U	U	U	U
Dinoseb	U	U	U	U	U	U
MCPA	U	U	U	U	U	U
MCPP	U	U	U	U	U	U
TTL PET. HYDROCARBONS (ug/g)	U	U	20	U	U	U
PCB/Pesticides (ug/kg)						
DDE	U	2.5 JP	160	17	U	49
DDD	U	2.4 J	U	U	U	U
DDT	220	7.1	35	5.3 P	U	50
Dieldrin	U	0.55 JP	36	U	U	10
Endrin	U	U	U	U	U	U
Methoxychlor	U	10 B	U	40 B	U	U
Endosulfan II	U	U	U	U	U	NA
Alpha Chlordane	NA	U	NA	U	NA	U
Aroclor 1254	U	U	U	U	U	U
Gamma-BHC (Lindane)	U	U	U	U	U	U
Beta-BHC	U	U	U	U	U	U
Endosulfan I	U	U	U	U	U	U
Endosulfan sulfate	U	U	U	U	U	U
Endrin ketone	NA	U	NA	U	NA	NA
ANIONS (ug/g)						
F	U	U	U	U	2	U
CL	U	3	9	14	7	6
PO4-P	U	U	U	U	U	U
So4	6	8	14	46	11	18
No3-N+No2-N	1	2	3	4	2	5
Cr-6	U	U	U	U	U	U
PHOSPH-PEST (ug/kg)						
TPP	NA	NA	NA	NA	NA	NA

SAMPLE NUMBER	B07GM6	B07GM7	B07GM8	B07GM9	B07GN0	B07GN1
LOCATION	H-04(W)/A-1-2	H-04(W)/A-1-3	H-04(W)/A-1-3	H-04(W)/A-1-3	H-04(W)/A-2-2	H-04(W)/A-3-1
COMMENTS	9-11 ft, SW-846	8-9 ft, CLP	8-9 ft, CLP, duplicate	8-9 ft, CLP, split	7.5-9.5 ft, SW-846	7-9 ft, SW-846
BNA - VOA (ug/kg)						
di-n-butylphthalate	U	U	130 J	U	U	64
diethyl phthalate	U	U	62 J	U	U	U
phenanthrene	U	U	U	U	U	U
fluoranthene	U	U	U	U	U	U
pyrene	U	U	U	U	U	U
benzo(a)anthracene	U	U	U	U	U	U
chrysene	U	U	U	U	U	U
benzo(b)fluoranthene	U	U	U	U	U	U
benzo(k)fluoranthene	U	U	U	U	U	U
benzo(a)pyrene	U	U	U	U	U	U
bis(2-ethylhexyl)phthalate	U	100 BJ	62 BJ	U	U	U
indeno(1,2,3-cd)pyrene	U	U	U	U	U	U
dibenzo(a,h)anthracene	U	U	U	U	U	U
benzo(g,h,i)perylene	U	U	U	U	U	U
VOA (ug/kg)						
acetone	67	34 B	34 B	42 B	31	48
2-hexanone	U	U	U	U	U	U
methylene chloride	U	U	U	28 B	U	1.3
toluene	U	U	U	U	U	2.6
methyl-pentanone	U	U	U	U	U	U
ICP METALS (ug/kg)						
Al	13000	14400	14400	15400	17000	20000
Sb	U	U N	U N	U N	U	U
Ba	110	401	431	348	200	130
Be	1	0.92 B	0.88 B	1.2	U	U
Cd	U	U	U	0.7 B	U	U
Ca	22000	17300	17600	18300	21000	10000
Cr	11	14.8	13.8	15.5	17	15
Co	9	8.2 B	9 B	10.2 B	9	11
Cu	13	29.5	21.5	20.9	14	16
Fe	11000	10000	19100	22000	20000	10000
Li	9	NA	NA	NA	15	13
Mg	5100	7480	7400	7260	8300	9200
Mn	230	200	334	362	300	370
Mo	U	NA	NA	NA	U	U
Ni	11	8.2 B	13.6	14.8	16	15
P	130	NA	NA	NA	450	500
K	1000	1580	1500	1820	1300	2000
Ag	U	U	U	16.5 N	U	U
Na	400	500 BE	500 E	708 B	720	800
Sr	68	NA	NA	NA	92	100
V	28	43.3	43.3	46.6	73	45
Zn	25	41.9	45.6	65.7	41	71
Hg		U	U	U		
As		5.6	5.5	U WN		
Pb		16.7	15	18.9 *		
Se		U NW	U NW	U WN		
Tl		0.32 B	U	U WN		
AA METALS (ug/kg)						
As	4.2				8.1	6.5
Pb	7.1				5.6	14
Se	U				U	U
Tl	U				U	U
MERCURY (ug/kg)	U				U	U

SAMPLE NUMBER LOCATION COMMENTS	B07GM46 H-04(W)/A-1-2 9-11 ft, SW-846	B07GM47 H-04(W)/A-1-3 6-9 ft, CLP	B07GM48 H-04(W)/A-1-3 6-9 ft, CLP, duplicate	B07GM49 H-04(W)/A-1-3 6-9 ft, CLP, split	B07GN0 H-04(W)/A-2-2 7.5-9.5 ft, SW-846	B07GN1 H-04(W)/A-3-1 7-9 ft, SW-846
HERBICIDES (ug/kg)						
2,4-D	U	U	U	U	U	U
2,4-DB	U	U	U	162	U	U
2,4,5-T	U	U	U	68.4	U	U
2,4,5-TP	U	U	U	U	U	U
Dalapon	U	U	U	U	U	U
Dicamba	U	U	U	U	U	U
Dichlorprop	U	U	U	162	U	U
Dinoseb	U	U	U	U	U	U
MCPA	U	U	U	U	U	U
MCPP	U	U	U	U	U	U
TTL PET. HYDROCARBONS (ug/g)	U	U	50		U	30
PCB/Pesticides (ug/kg)						
DDE	U	78	140	70.9	U	44
DDD	U	1.3 JP	1.5 JP	U	U	U
DDT	U	24	46	16.4	U	60
Dieldrin	U	U	U	NA	U	U
Endrin	U	0.057 JB	0.85 JP	U	U	U
Methoxychlor	U	300 B	3 PB	U	U	U
Endosulfan II	U	U	U	U	U	U
Alpha Chlordane	NA	U	U	U	NA	NA
Aroclor 1254	U	U	U	U	U	U
Gamma-BHC (Lindane)	U	U	U	U	U	U
Beta-BHC	U	U	U	U	U	U
Endosulfan I	U	U	U	U	U	U
Endosulfan sulfate	U	U	U	U	U	U
Endrin ketone	NA	U	U	U	NA	NA
ANIONS (ug/g)						
F	U	3	3	4.62	3	3
CL	33	27	28	32.6	62	100
PO4-P	U	U	U	0.82	U	U
So4	200	660	770	851	1300	3100
No3-N+No2-N	6	4	4	0.4	6	10
Cr-6	U	U	U	0.0076	U	U
PHOSPH-PEST (ug/kg)						
TPP	303	130	166	NA	305	320

SAMPLE NUMBER	B07GN2	B07GN3	B07GN4	B07GN5	B07GN6	B07GN7
LOCATION	H-04(E)/A-1-1	H-04(E)/A-1-2	H-06-H(W)/A-2-2	H-06-H(W)/A-6-2	H-06-H(W)/A-6-6	H-06-H(W)/A-7-1
COMMENTS	7-9 ft, SW-846	8-10 ft, CLP	9-11 ft, SW-846	9-11 ft, SW-846	9-11 ft, CLP	9-11 ft, SW-846
BNA - VOA (ug/kg)						
di-n-butylphthalate J	U	U	U	U	66 J	U
diethyl phthalate	970	U	U	U	22 J	U
phenanthrene	95 J	U	U	U	U	U
fluoranthene	220 J	U	U	U	U	U
pyrene	240 J	U	U	U	U	U
benzo(a)anthracene	220 J	U	U	U	U	U
chrysene	310 J	U	U	U	U	U
benzo(b)fluoranthene	400	U	U	U	U	U
benzo(k)fluoranthene	340 J	U	U	U	U	U
benzo(a)pyrene	360	U	U	U	U	U
bis(2-ethylhexyl)phthalate	970	96 BJ	U	U	68 BJ	U
indeno(1,2,3-cd)pyrene	300	U	U	U	U	U
dibenzo(a,h)anthracene	140 J	U	U	U	U	U
benzo(g,h,i)perylene	450	U	U	U	U	U
VOA (ug/kg)						
acetone	31	32 B	32	49	24 B	40
2-hexanone	U	U	U	U	U	U
methylene chloride J	U	U	U	U	U	U
toluene	U	U	U	U	U	U
methyl-pentanone	U	U	U	U	3 J	U
ICP METALS (ug/kg)						
Al	9700	10500	13000	10000	13300	12000
Sb	U	U N	U	U	U N	U
Ba	98	308	130	110	114	110
Be	U	0.78 B	U	U	0.54 B	U
Cd	U	U	U	U	U	U
Ca	14000	23000	14000	9000	14000	13000
Cr	11	12.6	18	14	19	18
Co	9	8.6 B	10	9	10.8	10
Cu	15	18.3	18	15	21.1	21
Fe	22000	10200	21000	20000	23400	21000
Li	10	NA	15	12	NA	15
Mg	6000	6180	7500	6000	7580	7100
Mn	350	341	420	380	466	550
Mo	U	NA	U	U	NA	U
Ni	13	9.9	19	18	19.2	18
P	730	NA	820	820	NA	820
K	1300	1250	2100	1800	2130	2000
Ag	U	U	U	U	U	U
Na	410	516 BE	630	650	588 BE	520
Sr	60	NA	54	42	NA	53
V	51	46.2	38	40	44.2	38
Zn	46	38.5	52	58	58.6	250
Hg		U			U	
As		6.8			8.1	
Pb		11.4 NS			16 NS	
Se		U			U NW	
Tl		U			U	
AA METALS (ug/kg)						
As	4.3		5.3	4.6		5.6
Pb	6.7		8.2	7.8		47
Se	U		U	U		U
Tl	U		U	U		U
MERCURY (ug/kg)	U		U	U		U

SAMPLE NUMBER LOCATION COMMENTS	B07GN2 H-04(E)/A-1-1 7-9 ft, SW-846	B07GN3 H-04(E)/A-1-2 8-10 ft, CLP	B07GN4 H-06-H(W)/A-2-2 9-11 ft, SW-846	B07GN5 H-06-H(W)/A-5-2 9-11 ft, SW-846	B07GN6 H-06-H(W)/A-5-5 9-11 ft, CLP	B07GN7 H-06-H(W)/A-7-1 9-11 ft, SW-846
HERBICIDES (ug/kg)						
2,4-D	U	U	U	U	U	U
2,4-DB	U	U	U	U	U	U
2,4,5-T	U	U	U	U	U	U
2,4,5-TP	U	U	U	U	U	U
Dalapon	U	U	U	U	U	U
Dicamba	U	U	U	U	U	U
Dichloroprop	U	U	U	U	U	U
Dinoseb	U	U	U	U	U	U
MCPA	U	U	U	U	U	U
MCPP	U	U	U	U	U	U
TTL PET. HYDROCARBONS (ug/g)	U	U	U	U	U	U
PCB/Pesticides (ug/kg)						
DDE	U	6.2	U	U	3.3 J	U
DDD	U	U	U	U	U	U
DDT	U	3 J	U	U	2.9 J	U
Dieldrin	U	U	U	U	U	U
Endrin	U	U	U	U	U	U
Methoxychlor	U	3 PB	U	U	5.7 B	U
Endosulfan II	U	U	U	U	U	U
Alpha Chlordane	NA	U	NA	NA	U	NA
Aroclor 1254	U	U	U	U	U	U
Gamma-BHC (Lindane)	U	U	U	U	U	U
Beta-BHC	U	U	U	U	U	U
Endosulfan I	U	U	U	U	U	U
Endosulfan sulfate	U	U	U	U	U	U
Endrin ketone	NA	U	NA	NA	U	NA
ANIONS (ug/g)						
F	3	3	4	2	3	6
CL	U	2	73	28	73	6
PO4-P	U	U	U	1.3	U	U
So4	28	13	270	200	170	42
No3-N+No2-N	1	2	6	3	3	2
Cr-6	U	U	U	U	U	U
PHOSPH-PEST (ug/kg)						
TPP	323	112	317	324	236	325

COMMENTS	9-11 ft, BW-846	Equip. Blank(sand) CLP	H-06-H(W)/A-10-2 9-11 ft, SW-846	B07GP1 H-06-H(W)/A-10-3 9-11 ft, CLP	B07GP2 H-06-H(E)/A-2-1 9-11 ft, SW-846	B07GP3 H-06H(E)/A-6-4 9-11 ft, BW-846
VOA (ug/kg)						
di-n-butylphthalate						
diethyl phthalate	U	U	400	110 J	110 J	91
phenanthrene	U	U	U	37 J	U	U
fluoranthene	U	U	U	U	U	U
pyrene	U	U	U	U	U	U
benzo(a)anthracene	U	U	U	U	U	U
chrysene	U	U	U	U	U	U
benzo(b)fluoranthene	U	U	U	U	U	U
benzo(k)fluoranthene	U	U	U	U	U	U
benzo(a)pyrene	U	U	U	U	U	U
bis(2-ethylhexyl)phthalate	U	U	U	U	U	U
indeno(1,2,3-cd)pyrene	U	U	U	U	U	U
dibenzo(a,h)anthracene	U	U	U	120 J	110 J	U
benzo(g,h,i)perylene	U	U	U	U	U	U
				U	U	U
VOA (ug/kg)						
acetone	33	21 B	22	21 B	26	22
2-hexanone	U	U	U	U	U	U
methylene chloride	U	U	U	U	U	U
toluene	U	U	U	U	U	U
methyl-pentanone	U	3 J	U	U	U	U
ICP METALS (ug/kg)						
Al	13000	131	15000	11100	10000	20000
Sb	U	UN	U	UN	U	U
Ba	120	1.4 B	130	120	130	130
Be	U	U	U	0.55 B	U	U
Cd	U	U	U	U	U	U
Ca	16000	20.9 B	13000	14000	17000	16000
Cr	18	U	23	17.9	25	25
Co	10	U	8	8.8 B	10	10
Cu	21	U	35	63.5	43	31
Fe	22000	170	20000	20000	26000	25000
Li	16	NA	18	NA	21	20
Mg	7600	20.8 B	7300	7250	9100	8800
Mn	430	3.9	470	424	500	400
Mo	U	NA	U	U	2	U
Ni	17	U	18	18.1	22	21
P	600	NA	610	NA	500	600
K	2100	U	2700	2230	3000	3100
Ag	U	U	U	U	U	U
Na	610	11.8 B	610	271 BE	700	500
Sr	68	NA	64	NA	65	64
V	38	U	42	38	44	43
Zn	58	U	67	72.2	62	61
Hg		U		U		
As		U		11.1		
Pb		0.65		20.1 S*		
Se		0.23 B		UNW		
Tl		U		0.6 B		
AA METALS (ug/kg)						
As	6.6		7.2		8.6	9.2
Pb	9.9		38		13	11
Se	U		U		U	U
Tl	U		U		U	U
MERCURY (ug/kg)	U		U		U	U

SAMPLE NUMBER LOCATION COMMENTS	B07QN8 H-06-H(W)/A-18-1 9-11 ft, SW-846	B07QN9 Equip. Blank(sand) CLP	B07QP0 H-06-H(W)/A-19-2 9-11 ft, SW-846	B07QP1 H-06-H(W)/A-19-3 9-11 ft, CLP	B07QP2 H-06-H(E)/A-2-1 9-11 ft, SW-846	B07QP3 H-06H(E)/A-6-4 9-11 ft, SW-846
HERBICIDES (ug/kg)						
2,4-D	U	U	U	U	U	U
2,4-DB	U	U	U	U	U	U
2,4,5-T	U	U	U	U	U	U
2,4,5-TP	U	U	U	U	U	U
Dalapon	U	U	U	U	U	U
Dicamba	U	U	U	U	U	U
Dichlorprop	U	U	U	U	U	U
Dinoseb	U	U	U	U	U	U
MCPA	U	U	U	U	U	U
MCPP	U	U	U	U	U	U
TTL PET. HYDROCARBONS (ug/g)	U	U	U	90	U	U
PCB/Pesticides (ug/kg)						
DDE	U	U	U	11 X	U	U
DDD	U	U	U	1.4 JPX	U	U
DDT	U	U	U	U	U	U
Dieldrin	U	U	U	2.3 JPX	U	U
Endrin	U	1.5 PB	U	10 PX	U	U
Methoxychlor	U	U	U	0.71 JPB	U	U
Endosulfan II	U	U	U	0.84 JPX	U	U
Alpha Chlordane	NA	U	NA	4.9 PX	NA	NA
Aroclor 1254	U	U	U	210 P	U	U
Gamma-BHC (Lindane)	NA	U	NA	U	NA	NA
Beta-BHC	U	U	U	U	U	U
Endosulfan I	U	U	U	U	U	U
Endosulfan sulfate	U	U	U	U	U	U
Endrin ketone	NA	U	NA	U	NA	NA
ANIONS (ug/g)						
F	4	U	3	3	5	3
CL	3	U	140	15	75	78
PO4-P	U	U	U	U	U	U
So4	200	U	140	1300	100	120
No3-N+No2-N	1	U	16	25	12	2
Cr-6	U	U	U	U	U	U
PHOSPH-PEST (ug/kg)						
TPP	336	347	U	U	U	U

SAMPLE NUMBER	B07G[illegible]4	B07K[illegible]4	B07K[illegible]5	B07K[illegible]6	B07K[illegible]7
LOCATION	Equip. Blank (sand)	H-06-H(E)/A-11-1	H-06-H(E)/A-11-1	H-06-H(E)/A-11-1	H-06-H(E)/A-11-2
COMMENTS	CLP	9-11 ft, CLP	9-11 ft, CLP, duplicate	9-11 ft, CLP, split	9-11 ft, BW-846
BELL-VOA (ug/kg)					
di-n-butylphthalate J	70 J	260 BJ	200 J	260 J	U
diethyl phthalate	30 J	U	U	U	U
phenanthrene	U	U	U	U	U
fluoranthene	U	U	U	U	U
pyrene	U	U	U	U	U
benzo(a)anthracene	U	U	U	U	U
chrysene	U	U	U	U	U
benzo(b)fluoranthene	U	U	U	U	U
benzo(k)fluoranthene	U	U	U	U	U
benzo(a)pyrene	U	U	U	U	U
bis(2-ethylhexyl)phthalate	U	U	U	U	U
indeno(1,2,3-cd)pyrene	U	U	U	U	U
dibenzo(a,h)anthracene	U	U	U	U	U
benzo(g,h,i)perylene	U	U	U	U	U
VOA (ug/kg)					
acetone	23 B	25 B	73 B	7 JB	12
2-hexanone	U	U	U	U	U
methylene chloride	U	U	U	6 JB	U
toluene	U	U	U	U	U
methyl-pentanone	U	U	U	U	U
ICP METALS (ug/kg)					
Al	138	13300	13000	13400	10000
Sb	U	U N	13.9 N	U	U
Ba	1.5 B	163	187	157	150
Be	U	0.61 B	0.6 B	0.64 B	U
Cd	U	U	1.9	0.64 B	U
Ca	26.9 B	15000	16100	16100	16000
Cr	U	20.2	22.4	21	26
Co	U	10.5 B	11.4	14.6	10
Cu	U	22.3	24.2	27.1	24
Fe	185	24400	30300	27800	20000
Li	NA	NA	NA	NA	21
Mg	U	7580	7810	7700	9000
Mn	4.3	524	533	671	500
Mo	NA	NA	NA	NA	U
Ni	U	20.8	19.6	20.8	23
P	NA	NA	NA	NA	580
K	U	2170	2220	2330	2600
Ag	U	U	U	7	U
Na	7.5 B	307 BE	373 BE	U	600
Sr	NA	NA	NA	NA	60
V	U	45.5	47.3	52.2	44
Zn	U	117	161	96.1	73
Hg	U	U	U	U	
As	U	7.3	6.3	10.6 B	
Pb	0.32 B	100 *	26.5 S*	29.9	
Se	U	U NW	U NW	U	
Tl	U	0.24 B	U	U	
AA METALS (ug/kg)					
As					5.1
Pb					21
Se					U
Tl					U
MERCURY (ug/kg)					U

SAMPLE NUMBER	B07GP4	B07KP4	B07KP5	B07KP6	B07KP7
LOCATION	Equip. Blank (sand)	H-06-H(E)/A-11-1	H-06-H(E)/A-11-1	H-06-H(E)/A-11-1	H-06-H(E)/A-11-2
COMMENTS	CLP	9-11 ft, CLP	9-11 ft, CLP, duplicate	9-11 ft, CLP, split	9-11 ft, SW-846
HERBICIDES (ug/kg)					
2,4-D	U	U	U	U	U
2,4-DB	U	U	U	U	U
2,4,5-T	U	U	U	U	U
2,4,5-TP	U	U	U	U	U
Dalapon	U	U	U	U	U
Dicamba	U	U	U	U	U
Dichloroprop	U	U	U	U	U
Dinoseb	U	U	U	U	U
MCPA	U	U	U	U	U
MCPP	U	U	U	U	U
TTL PET. HYDROCARBONS (ug/g)	U	20	U	U	U
PCB/Pesticides (ug/kg)					
DDE	U	150 PY	170 PY	282 EC	34
DDD	U	1.4 JP	2.2 JP		U
DDT	U	210 PY	200 PY	341 EC	36
Dieldrin	0.061 JP	4 P	7.5	U	U
Endrin	U	U	U	U	U
Methoxychlor	0.55 JPB	2.4 JPB	1.7 JPB	U	U
Endosulfan II	U	U	U	U	U
Alpha Chlordane	U	U	U	U	NA
Aroclor 1254	U	U	U	U	U
Gamma-BHC (Lindane)	U	U	U	U	NA
Beta-BHC	U	U	U	U	U
Endosulfan I	U	U	U	U	U
Endosulfan sulfate	U	U	U	U	U
Endrin ketone	U	U	U	U	NA
ANIONS (ug/g)					
F	U	2	1	1.96	6
CL	2	7	7	10.9	9
PO4-P	U	U	U	1.43	U
So4	1	630	550	311	42
No3-N+No2-N	U	2	2	13.01 <.2	2
Cr-6	U	U	U	<0.133	U
PHOSPH-PEST (ug/kg)					
TPP	U	U	U	NA	NA

SAMPLE NUMBER	B07K79	B07K79	B07K00	B07K01	B07K02	B07K03
LOCATION	H-06-H(E)/A-12-1	H-06-H(E)/A-12-2	H-06-H(E)/A-7-1	H-81-A	H-06-L	H-06-L
COMMENTS	9-11 ft, CLP	9-11 ft, SW-846	9-11 ft, SW-846	4-6 ft, CLP	3 ft, CLP	13-15 ft, CLP
BELS-VOA (ug/kg)						
di-n-butylphthalate	63 J	U	U	U	U	U
diethyl phthalate	U	U	U	U	U	U
phenanthrene	U	U	U	U	U	U
fluoranthene	U	U	U	U	U	U
pyrene	U	U	U	U	U	U
benzo(a)anthracene	U	U	U	U	U	U
chrysene	U	U	U	U	U	U
benzo(b)fluoranthene	U	U	U	U	U	U
benzo(k)fluoranthene	U	U	U	U	U	U
benzo(a)pyrene	U	U	U	U	U	U
bis(2-ethylhexyl)phthalate	80 J	U	82 J	U	U	U
indeno(1,2,3-cd)pyrene	U	U	U	U	U	U
dibenzo(a,h)anthracene	U	U	U	U	U	U
benzo(g,h,i)perylene	U	U	U	U	U	U
VOA (ug/kg)						
acetone	40 B	10	11	U	U	U
2-hexanone	U	U	U	U	U	U
methylene chloride	U	U	U	U	U	U
toluene	U	U	U	U	U	U
methyl-pentanone	U	U	U	U	U	U
ICP METALS (ug/g)						
Al	18100	20000	17000	7900	11500	20800
Sb	UN	U	U	UN	UN	UN
Ba	148	150	200	88.4	114	41.9 B
Be	0.76 B	U	U	0.47 B	0.70 B	1.3
Cd	U	U	U	U	U	U
Ca	17300	17000	16000	10800	12400	113000
Cr	24.1	25	25	10.4	16.5	23.1
Co	11.5	11	10	10.1 B	9.9 B	8.4 B
Cu	29.2	26	21	21.7	37.8	22.8
Fe	27300	26000	24000	29700	22100	23200
Li	NA	21	19	NA	NA	NA
Mg	8000	9200	8500	5830	6130	12100
Mn	407	510	400	475	417	176
Mo	NA	U	U	NA	NA	NA
Ni	20.3	22	20	13.1	13.6	16.3
P	NA	610	600	NA	NA	NA
K	2830	3000	2700	1120	2540	1610
Ag	U	U	U	U	U	U
Na	578 BE	570	610	189 B	235 B	719 BB
Sr	NA	62	62	NA	NA	NA
V	46.1	43	43	70.7	48.6	97.3
Zn	108	85	58	65.8	92.3	65.1
Hg	U			U	U	U
As	9.3			1.9	4.3	6.8
Pb	22.7 *			48.4	28.1	12 S
Se	UNW			UNW	UNW	UNW
Tl	U			U	U	U
AA METALS (ug/g)						
As		8.8	8.5			
Pb		14	11			
Se		U	U			
Tl		U	U			
MERCURY (ug/g)		U	U			

SAMPLE NUMBER	B07KP8	B07KP9	B07KQ0	B07KQ1	B07KQ2	B07KQ3
LOCATION	H-06-H(E)/A-12-1	H-06-H(E)/A-12-2	H-06-H(E)/A-7-1	H-81-A	H-06-L	H-06-L
COMMENTS	9-11 ft, CLP	9-11 ft, SW-846	9-11 ft, SW-846	4-6 ft, CLP	3 ft, CLP	13-15 ft, CLP
HERBICIDES (ug/kg)						
2,4-D	U	U	U	U	U	U
2,4-DB	U	U	U	U	U	U
2,4,5-T	U	U	U	U	U	U
2,4,5-TP	U	U	U	U	U	U
Dalapon	U	U	U	U	U	U
Dicamba	U	U	U	U	U	U
Dichloroprop	U	U	U	U	U	U
Dinoseb	U	U	U	U	U	U
MCPA	U	U	U	U	U	U
MCPP	U	U	U	U	U	U
TTL PET. HYDROCARBONS (ug/g)	U	U	U	910	U	U
PCB/Pesticides (ug/kg)						
DDE	100 PY	U	U	U	2.2 J	U
DDD	2.1 JP	U	U	U	U	U
DDT	06 PY	U	U	U	4.9	U
Dieldrin	10 P	U	U	0.46 JP	U	U
Endrin	0.60 JP	U	U	U	0.88 J	U
Methoxychlor	1.6 JPB	U	U	1.3 JPB	2.2 JPB	2 JB
Endosulfan II	U	U	U	U	U	U
Alpha Chlordane	U	NA	NA	0.35 JP	U	U
Aroclor 1254	U	U	U	U	U	U
Gamma-BHC (Lindane)	1.2 JP	NA	NA	U	U	U
Beta-BHC	U	U	U	1.9 P	U	U
Endosulfan I	U	U	U	0.13 JP	U	U
Endosulfan sulfate	U	U	U	1.6 JP	0.10 JP	0.21 JP
Endrin ketone	U	NA	NA	U	U	U
ANIONS (ug/g)						
F	4	5	5	U	U	4
CL	62	4	28	3	6	2
PO4-P	U	U	U	U	6	U
So4	160	45	240	14	28	330
No3 NH+No2-N	6	U	1	5	77	3
Cr-C	U	U	U	3	21	U
PHOSPH-PEST (ug/kg)						
TPP	NA	NA	NA	300	310	350

SAMPLE NUMBER LOCATION COMMENTS	B07K04 Firm - ctsed 8 in, CLP	B07K05 2,4-D 13-15 ft, CLP	B07K06 2,4-D 13-15 ft, SW-846	B07K07 2,4-D CLP	B07K13 H-12-L 4 ft, CLP	B07K14 H-12-L 4 ft, SW-846
SEMI-VOA (ug/kg)						
di-n-butylphthalate	100 BJ					
diethyl phthalate	U	U	U	U	NA	NA
phenanthrene	U	U	U	U	NA	NA
fluoranthene	U	U	U	U	NA	NA
pyrene	U	U	U	U	NA	NA
benzo(a)anthracene	U	U	U	U	NA	NA
chrysene	U	U	U	U	NA	NA
benzo(b)fluoranthene	U	U	U	U	NA	NA
benzo(k)fluoranthene	U	U	U	U	NA	NA
benzo(a)pyrene	U	U	U	U	NA	NA
bis(2-ethylhexyl)phthalate	U	U	U	U	NA	NA
indeno(1,2,3-cd)pyrene	U	U	U	U	NA	NA
dibenzo(a,h)anthracene	U	U	U	U	NA	NA
benzo(g,h,i)perylene	U	U	U	U	NA	NA
VOA (ug/kg)						
acetone	NA	NA	NA	NA	NA	NA
2-hexanone	NA	NA	NA	NA	NA	NA
methylene chloride	NA	NA	NA	NA	NA	NA
toluene	NA	NA	NA	NA	NA	NA
methyl-pentanone	NA	NA	NA	NA	NA	NA
ICP METALS (mg/kg)						
Al	7410	NA	NA	NA	7050	7100
Sb	10.5 N	NA	NA	NA	U	U
Ba	128 N	NA	NA	NA	71.3	59
Be	U	NA	NA	NA	0.39 B	U
Cd	U	NA	NA	NA	U	U
Ca	4100	NA	NA	NA	4300	3200
Cr	16.8 N	NA	NA	NA	11.4	11
Co	9.5 B	NA	NA	NA	7.8 B	8
Cu	40.7 N*	NA	NA	NA	17.3	10
Fe	30000 *	NA	NA	NA	16300	16000
Li	NA	NA	NA	NA	NA	8
Mg	3000	NA	NA	NA	4120	4000
Mn	422 N	NA	NA	NA	267 N	250
Mo	NA	NA	NA	NA	NA	U
Ni	23.4 *	NA	NA	NA	6.7 B	10
P	1550	NA	NA	NA	1000	530
K	NA	NA	NA	NA	NA	1300
Ag	U	NA	NA	NA	U	U
Na	175 B	NA	NA	NA	411 B	220
Sr	NA	NA	NA	NA	NA	19
V	45.3	NA	NA	NA	35.2	38
Zn	144 N*	NA	NA	NA	33.6	34
Hg	U	NA		NA	U N	
As	3.4 NS	NA		NA	2.3	
Pb	216	NA		NA	4.7 NS	
Se	0.35 B	NA		NA	0.24 B	
Tl	0.18 BW	NA		NA	0.1 B	
AA METALS (mg/kg)						
As		NA	NA	NA		1.6
Pb		NA	NA	NA		4.3
Se		NA	NA	NA		U
Tl		NA	NA	NA		U
MERCURY (mg/kg)		NA	NA	NA		U

SAMPLE NUMBER	B07K04	B07K06	B07K08	B07K07	B07K13	B07K14
LOCATION	Hm - shed	2,4-D	2,4-D	2,4-D	H-12-L	H-12-L
COMMENTS	6 in, CLP	13-15 ft, CLP	13-15 ft, BW-846	CLP	4 ft, CLP	4 ft, BW-846
HERBICIDES (ug/kg)						
2,4-D	U	U	U	U	NA	NA
2,4-DB	U	U	U	U	NA	NA
2,4,5-T	U	U	U	U	NA	NA
2,4,5-TP	U	U	U	U	NA	NA
Dalapon	U	U	U	U	NA	NA
Dicamba	U	U	U	U	NA	NA
Dichloroprop	U	U	U	U	NA	NA
Dinoseb	U	U	U	U	NA	NA
MCPA	U	U	U	U	NA	NA
MCPP	U	U	U	U	NA	NA
TTL PET. HYDROCARBONS (ug/kg)	U	NA	NA	NA	NA	NA
PCB/Pesticides (ug/kg)						
DDE	U	U	SEE RECORD OF DISPOSITION	U	NA	NA
DDD	U	U		U	NA	NA
DDT	4.5	U		U	NA	NA
Dieldrin	1.2 JP	U		U	NA	NA
Endrin	U	U		U	NA	NA
Methoxychlor	2.5 JPB	U		U	NA	NA
Endosulfan II	U	U		U	NA	NA
Alpha Chlordane	U	U		U	NA	NA
Aroclor 1254	U	U		U	NA	NA
Gamma-BHC (Lindane)	U	U		U	NA	NA
Beta-BHC	U	U		U	NA	NA
Endosulfan I	U	U		U	NA	NA
Endosulfan sulfate	U	0.070 JP		U	NA	NA
Endrin ketone	0.47 JP	U		U	NA	NA
ANIONS (ug/g)						
F	U	NA	NA	NA	15	U
CL	12	NA	NA	NA	55	20
PO4-P	5	NA	NA	NA	U	U
So4	11	NA	NA	NA	31	20
No3-N+No2-N	2	NA	NA	NA	1	1
Cr-6	U	NA	NA	NA	2	2
PHOSPH-PEST (ug/kg)						
TPP	230.5	330	370	370	NA	NA

SAMPLE NUMBER LOCATION COMMENTS	B07K015 H-07-H 16 ft, CLP	B07K016 H-07-H 16 ft, CLP duplicate	B07K017 H-07-H 16 ft, CLP split	B07K018 H-06-H 9-11 ft, CLP	B07K019 H-00 SW-846
SEMI-VOA (ug/kg)					
di-n-butylphthalate	U	U	U	U	NA
diethyl phthalate	U	U	U	U	NA
phenanthrene	U	U	U	U	NA
fluoranthene	U	U	U	U	NA
pyrene	U	U	U	U	NA
benzo(a)anthracene	U	U	U	U	NA
chrysene	U	U	U	U	NA
benzo(b)fluoranthene	U	U	U	U	NA
benzo(k)fluoranthene	U	U	U	U	NA
benzo(a)pyrene	U	U	U	U	NA
bis(2-ethylhexyl)phthalate	U	U	U	32 BJ	NA
indeno(1,2,3-cd)pyrene	U	U	U	U	NA
dibenzo(a,h)anthracene	U	U	U	U	NA
benzo(g,h,i)perylene	U	U	U	U	NA
VOA (ug/kg)					
acetone	7 J	U	8 J	U	NA
2-hexanone	U	U	U	U	NA
methylene chloride	2 BJ	3 BJ	U	3 BJ	NA
toluene	U	0.6 BJ	U	U	NA
methyl-pentanone	U	U	U	U	NA
ICP METALS (ug/kg)					
Al	11800	11900	11600	43.6	6500
Sb	U	U	5.4 BM	U	U
Ba	88	86.4	96.1	86.4	90
Be	0.56 B	0.56 B	0.09 B	U	U
Cd	1.2	1 B	1.6	U	U
Ca	11200	11000	12200	16.3 B	10000
Cr	17.6	16.4	17.1	U	12
Co	10.2 B	11.7	11.6	U	6
Cu	25.4	24.4	28.6	1.5 B	31
Fe	20600	20000	22000	320	16000
Li	NA	NA	NA	NA	6
Mg	6460	6320	6070	61 B	3000
Mn	310	303	360	U	240
Mo	NA	NA	NA	NA	U
Ni	17	13.4	16.9	U	9
P	2000	2130	NA	171 B	800
K	NA	NA	21.6	NA	1200
Ag	0.95 B	1.1 B	U	0.77 B	U
Na	413 B	412 B	181 B	18.2 B	320
Sr	NA	NA	NA	NA	41
V	41.1	30.9	46.4	U	46
Zn	92.3	88.2	103	U	200
Hg	U N	U N	U	U	
As	5.7	6	6.1 N	0.16 B	
Pb	19.7 N*	20.6 N*	21.3	0.16 B	
Se	0.41 BS	0.37 BW	0.52 B	0.27 B	
Tl	U	0.13 B	U N	U	
AA METALS (ug/kg)					
As					600
Pb					1200
Se					U
Tl					U
MERCURY (ug/kg)					0.09

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SAMPLE NUMBER LOCATION COMMENTS	B07K15 H-07-H 16 ft, CLP	B07K16 H-07-H 16 ft, CLP duplicate	B07K17 H-07-H 16 ft, CLP split	B07K18 H-06-H 9-11 ft, CLP	B07K19 H-90 SW-846
HERBICIDES (ug/kg)					
2,4-D	U	U	245	U	NA
2,4-DB	U	U	1210 B	U	NA
2,4,5-T	U	U	U	U	NA
2,4,5-TP	U	U	U	U	NA
Dalapon	U	U	NA	U	NA
Dicamba	U	U	U	U	NA
Dichloroprop	U	U	U	U	NA
Dinoseb	U	U	U	U	NA
MCPA	U	U	NA	U	NA
MCPP	U	U	NA	U	NA
TTL PET. HYDROCARBONS (ug/g)	60	60	72 mg/kg	U	60000
PCB/Pesticides (ug/kg)					
DDE	0.55 JP	0.55 JP	U	U	NA
DDD	1.1 P	1.2 P	U	U	NA
DDT	3.2 JP	3.1 J	NA	U	NA
Dieldrin	1.6 J	1.6 JP	U	U	NA
Endrin	U	U	U	U	NA
Methoxychlor	7.6 J	6.4 J	U	5.5 J	NA
Endosulfan II	U	0.57 PB	U	U	NA
Alpha Chlordane	U	U	U	U	NA
Aroclor 1254	U	U	U	U	NA
Gamma-BHC (Lindane)	U	U	U	U	NA
Beta-BHC	U	U	U	U	NA
Endosulfan I	U	U	U	U	NA
Endosulfan sulfate	U	U	U	U	NA
Endrin ketone	U	U	U	U	NA
ANIONS (ug/g)					
F	U	U	1.42	U	NA
CL	7	10	6.35	7	NA
PO4-P	U	U	4.68	U	NA
So4	26	26	23.7	6	NA
No3-N+No2-N	14	14	27.9	U	NA
Cr-6	2	2	<2.74 mg/kg	2	NA
PHOSPH-PEST (ug/kg)					
TPP	450	460	NA	450	NA

SAMPLE NUMBER	B07K90	B07K91	B07K92
LOCATION	H-00	H-00	H-00
COMMENTS	SW-846	6 in, SW-846	6 in, CLP
SEMI-VOA (ug/kg)			
di-n-butylphthalate	NA	NA	NA
diethyl phthalate	NA	NA	NA
phenanthrene	NA	NA	NA
fluoranthene	NA	NA	NA
pyrene	NA	NA	NA
benzo(a)anthracene	NA	NA	NA
chrysene	NA	NA	NA
benzo(b)fluoranthene	NA	NA	NA
benzo(k)fluoranthene	NA	NA	NA
benzo(a)pyrene	NA	NA	NA
bis(2-ethylhexyl)phthalate	NA	NA	NA
indeno(1,2,3-cd)pyrene	NA	NA	NA
dibenzo(a,h)anthracene	NA	NA	NA
benzo(g,h,i)perylene	NA	NA	NA
VOA (ug/kg)			
acetone	NA	NA	NA
2-hexanone	NA	NA	NA
methylene chloride	NA	NA	NA
toluene	NA	NA	NA
methyl-pentanone	NA	NA	NA
ICP METALS (ug/kg)			
Al	7700	7400	8450
Sb	U	U	10.0 N*
Ba	100	92	95.6
Be	U	U	0.52 B
Cd	1	U	U
Ca	9100	9200	11000
Cr	14	13	10.2
Co	7	6	11
Cu	20	23	18.2
Fe	10000	20000	20000
Li	6	7	NA
Mg	4300	4200	4420
Mn	250	350	391 N
Mo	U	U	NA
Ni	11	11	8.8
P	860	760	1430
K	1400	1400	NA
Ag	U	U	0.94 B
Na	440	270	610 BE
Sr	37	31	NA
V	48	52	51.5
Zn	400	230	58.5
Hg			U N
As			3.4
Pb			68.5 N*
Se			0.32 B
Tl			0.14 B
AA METALS (ug/kg)			
As	3.1	2.1	
Pb	760	120	
Se	U	U	
Tl	U	U	
MERCURY (ug/kg)	U	U	

SAMPLE NUMBER	B07K30	B07K31	B07K32
LOCATION	H-90	H-90	H-90
COMMENTS	SW-846	6 in, SW-846	6 in, CLP
HERBICIDES (ug/kg)			
2,4-D	NA	NA	NA
2,4-DB	NA	NA	NA
2,4,5-T	NA	NA	NA
2,4,5-TP	NA	NA	NA
Dalapon	NA	NA	NA
Dicamba	NA	NA	NA
Dichloroprop	NA	NA	NA
Dinoseb	NA	NA	NA
MCPA	NA	NA	NA
MCPP	NA	NA	NA
TTL PET. HYDROCARBONS (ug/g)	65000	940	1700
PCB/Pesticides (ug/kg)			
DDE	NA	NA	NA
DDD	NA	NA	NA
DDT	NA	NA	NA
Dieldrin	NA	NA	NA
Endrin	NA	NA	NA
Methoxychlor	NA	NA	NA
Endosulfan II	NA	NA	NA
Alpha Chlordane	NA	NA	NA
Aroclor 1254	NA	NA	NA
Gamma-BHC (Lindane)	NA	NA	NA
Beta-BHC	NA	NA	NA
Endosulfan I	NA	NA	NA
Endosulfan sulfate	NA	NA	NA
Endrin ketone	NA	NA	U
ANIONS (ug/g)			
F	NA	NA	NA
CL	NA	NA	NA
PO4-P	NA	NA	NA
So4	NA	NA	NA
No3-N+No2-N	NA	NA	NA
Cr-6	NA	NA	NA
PHOSPH-PEST (ug/kg)			
TPP	NA	NA	NA

ORGANIC DATA QUALIFIERS

U - Indicates compound was analyzed for but not detected.
J - Indicates an estimated value.
P - This flag is used for a pesticide/Aroclor target analyte when there is greater than 25% difference for detected concentrations between the two GC columns.
C - This flag applies to pesticide results where the identification has been confirmed by GC/MS.
B - This flag is used when the analyte is found in the associated blank as well as in the sample.
E - This flag identifies compounds whose concentrations exceeded the calibration range of the GCMS instrument for that specific analysis.
D - This flag identifies all compounds identified in a analysis at a secondary dilution factor.
A - This flag indicates that a TIC is a suspected aldol-condensation product.
N - Indicates presumptive evidence of a compound.

INORGANIC DATA QUALIFIERS

C (Concentration) Qualifier: "B" will be entered if the reported value was obtained from a reading that was less than the Contract Required Detection. Limit (CRDL) but greater than or equal to the Instrument Detection Limit (IDL). If the analyte was analyzed for but not detected, a "U" will be entered. The field will be left blank if the result is above the CRDL.

Q Qualifier: Specified entries and their meanings are as follows:
E - The reported value is estimated because of the presence of interference. An explanatory note must be included under Comments on the Cover Page or on the specific FORM I - IN.
M - Duplicate injection precision of 20% not met.
N - Spiked sample recovery not within control limits of 75-125%.
S - The reported value was determined by the Method of Standard Additions (MSA).
W - Post-digestion spike for Furnace AA analysis is out of control limits (85-115%), while sample absorbance is less than 50% of spike absorbance.
* - Duplicate analysis not within control limits of 20% or +/- CRDL.
+ - Correlation coefficient for the MSA is less than 0.995.

PESTICIDE/PCB ANALYSIS

X - Used to flag the results of single component target pesticides in samples found to contain Aroclor 1254.
Y - Used to flag the results of compounds which were detected at levels above the concentration of the high standard.

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Appendix D

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APPENDIX D

FIELD FORMS

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FE

CI IN OF CUSTODY RECORD

CDM Federal Programs Corporation

PROJECT NAME _____ PROJECT NUMBER _____

Field Log Book Reference No. _____

SAMPLE NUMBER			DATE	TIME	SAMPLE LOCATION	SAMPLE TYPE	ANALYSES									NUMBER OF CONTAINERS	LOG. BOOK PG. NO.	REMARKS

SAMPLED BY (SIGN) _____ / _____ / _____ / _____

RELINQUISHED BY (SIGN)	RELINQUISHED BY (SIGN)	RELINQUISHED BY (SIGN)	RELINQUISHED BY (SIGN)	RELINQUISHED BY (SIGN)
① _____	② _____	③ _____	④ _____	⑤ _____
DATE/TIME (/)	DATE/TIME (/)	DATE/TIME (/)	DATE/TIME (/)	DATE/TIME (/)
RECEIVED BY (SIGN)	RECEIVED BY (SIGN)	RECEIVED BY (SIGN)	RECEIVED BY (SIGN)	RECEIVED BY (SIGN)
① _____	② _____	③ _____	④ _____	⑤ _____
DATE/TIME (/)	DATE/TIME (/)	DATE/TIME (/)	DATE/TIME (/)	DATE/TIME (/

METHOD OF SHIPMENT	SHIPPED BY (SIGN)	RECEIVED FOR LABORATORY BY (SIGN)	DATE/TIME
_____	_____	_____	(/) _____

Copies: Ship with Samples

Legend: Original: Return to Sample Traffic Control Center

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CDM Federal Programs Corporation		
Site or Sample Number	Date	Time
Analysis	Preservative	
	Sampler	
	Grab	Composite
	Soil	Water

Sample Label

CDM Federal Programs Corporation	SAMPLE NO.	DATE	seal broken by	date
	SIGNATURE			
	PRINT NAME AND TITLE			

Chain of Custody Label

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(SAMPLE FORMAT)

ER 1110-1-263
1 Oct 90

A-E DAILY QUALITY CONTROL REPORT

DATE _____

DAY	S	M	T	W	TH	F	S

WEATHER	Bright Sun	Clear	Overcast	Rain	Snow
TEMP	To 32	32-50	50-70	70-85	85 up
WIND	Still	Moderate	High	Recorn No.	
HUMIDITY	Dry	Moderate	Humid		

COE PROJECT MANAGER _____

PROJECT _____

JOB NO. _____

CONTRACT NO _____

SUB-CONTRACTORS ON SITE:

EQUIPMENT ON SITE.

WORK PERFORMED (INCLUDING SAMPLING):

SHEET ____ OF ____

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ER 1110-1-263
1 Oct 90

(Continuation Sheet)

PROJECT: _____ REPORT NO. _____

JOB NO. _____ DATE _____

QUALITY CONTROL ACTIVITIES (INCLUDING FIELD CALIBRATIONS)

HEALTH AND SAFETY LEVELS AND ACTIVITIES.

PROBLEMS ENCOUNTERED/CORRECTION ACTION TAKEN:

SPECIAL NOTES.

TOMORROWS EXPECTATIONS:

BY _____ TITLE _____

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APPENDIX E

STANDARD OPERATING PROCEDURES

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Prepared: 12/23/92 Signature/Date Technical Review 1-4-93 Signature/Date

QA Review: 1/2/92 Signature/Date Approved: 3/11/93 Signature/Date

Issued: 4/23/93 Signature/Date

1.0 OBJECTIVE

Due to the evidentiary nature of samples collected during environmental investigations, possession must be traceable from the time the samples are collected until their derived data are introduced as evidence in legal proceedings. To maintain and document sample possession, sample custody procedures are followed. All paper work associated with the sample custody procedures will be retained in CDM Federal Programs Corporation (CDM Federal) files unless the client requests that it be transferred to them for use in legal proceedings or at the completion of the contract.

2.0 BACKGROUND

2.1 Definitions

Sample - A material to be analyzed that is contained in single or multiple containers representing a unique sample identification number.

Sample Custody - A sample is under custody if:

1. It is in your possession.
2. It is in your view, after being in your possession.
3. It was in your possession and you locked it up.
4. It is in a designated secure area.

Chain-of-Custody Record - Form used to document the transfer of custody of samples from one individual to another.

Custody Seal - A custody seal is a tape-like seal that is part of the chain-of-custody process and is used to prevent tampering with samples after they have been packed for shipping.
Sample Tag - Tag generated by EPA's Contract Laboratory Program (CLP) for designating a CLP sample number on samples.

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3.0 RESPONSIBILITIES

Sampler - The sampler is personally responsible for the care and custody of the samples collected until they are properly transferred or dispatched.

Site Manager - The site manager is responsible for ensuring that strict chain-of-custody procedures are maintained during all sampling events.

4.0 REQUIRED EQUIPMENT

- Chain-of-Custody Records (applicable CLP or CDM Federal forms)
- Custody Seals
- Sample Tags

Note: The CLP sample coordinator will supply the appropriate Chain-of-Custody Records, sample tags, and CLP sample numbers.

5.0 PROCEDURES

5.1 Chain-of-Custody Record

This procedure establishes a method for maintaining custody of samples through use of a Chain-of-Custody Record. This procedure will be followed for all samples collected or split samples accepted.

Field Custody

1. Collect only the number of samples needed to represent the media being sampled. To the extent possible, determine the quantity and types of samples and sample locations prior to the actual field work. As few people as possible should handle samples.

2. The field sampler is personally responsible for the care and custody of the samples collected until they are properly transferred or dispatched.

3. Sample labels shall be completed for each sample, using waterproof ink; sample tags shall also be completed for CLP work.

4. The Site Manager determines whether proper custody procedures were followed during the field work and decides if additional samples are required.

Transfer of Custody and Shipment

1. Samples are accompanied by a Chain-of-Custody Record (see Figure 1; Chain-of-Custody Record). When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents sample custody transfer from the sampler, often through another person, to the analyst in the appropriate laboratory.

   - The date/time will be the same for both signatures when custody is transferred directly to another person. When samples are shipped via common carrier (e.g., Federal Express), the date/time will not be the same for both signatures. Common carriers are not required to sign the form.

   - In all cases, it must be readily apparent that the person who received custody is the same person who relinquished custody to the next custodian.

   - If samples are left unattended or a person refuses to sign, this must be documented and explained on the Chain-of-Custody Record.

2. Samples will be packaged properly for shipment and dispatched to the appropriate laboratory for analysis, with a separate custody record accompanying each shipment.

3. All shipments will be accompanied by the Chain-of-Custody Record identifying its contents. The original record will accompany the shipment, and the copies will be retained by the Site Manager and if applicable, distributed to the appropriate CLP sample coordinators. Freight bills will also be retained by the Site Manager as part of the permanent documentation.

Procedure for Completing CDM Federal Chain-of-Custody Record

Note: Refer to EPA Regional guidelines for completing CLP custody records.

1. Record Project Number.

2. Record Field Team Leader for the project.

3. Record the name and address of the laboratory to which samples are being shipped.

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4. Record the record number and total number of records being shipped for the day.

5. Enter the project name/location or code number.

6. Record overnight courier's airbill number.

7. Note sample type (matrix) and reference number. Include reference number if requested on the Chain-of-Custody Record, box 9.

8. Record sample identification number.

9. Enter the reference number from box #7. Record equipment rinseates, trip blanks, or source blanks on CLP Chain-of-Custody Records as directed by the EPA Region.

10. Enter date of sample collection.

11. Enter time of sample collection in military time.

12. Enter an X in appropriate box for sample designation - composite or grab.

13. Samplers must enter their initials next to the samples they collected.

14. List parameters for analysis and the number of containers submitted for each analysis.

15. Enter MS/MSD or MS if sample is for laboratory QC, or other remarks, e.g., sample depth.

16. Record the type of preservative added by reference number and sample pH. Use the remarks column if no space is dedicated to preservative.

17. <u>All</u> samplers must sign in the space provided.

18. The originator checks information entered in 1 through 17 and then signs the top left "Relinquished by" box and enters the current date and time (military).

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- Upon completion of the custody record form, the white and pink copies shall be sent with the samples to the laboratory; the yellow copy is retained for the project files. Additional copies will be retained for the project file or distributed as required to the appropriate sample coordinators for CLP work.

19. The laboratory sample custodian receiving the samples checks the sample label information against the custody record form. He or she also checks sample condition and notes anything unusual under "Remarks" on the custody record form. The laboratory custodian receiving custody signs in the adjacent "Received by" box and keeps the pink copy. The white copy is returned to CDM Federal.

5.2 Sample Tags for CLP Projects

Sample tags will be utilized for all samples collected or accepted for CLP projects.

1. All sample tags will be securely attached to the sample bottle. On 80 oz. amber bottles, the tag string may be looped through the ring style handle and tied. On all other containers, it is recommended that the string be looped around the neck of the bottle, then twisted and relooped around the neck until the slack in the string is removed.

2. One tag will be completed for each sample container collected. Each tag will be completed as follows (see Figure 2: EPA CLP Sample Tag) (check with your EPA Regional guidelines for variations):

   - Under the "Remarks" heading, enter the CLP Case Number and record the CLP sample number.
   - Record the Project Code assigned by EPA.
   - Enter the Station Number if applicable.
   - Record the date to indicate the month, day, and year of sample collection.
   - Enter the time (military) of sample collection.
   - Place a check to indicate composite or grab sample.
   - Record the sample location.
   - Samplers must sign in the space provided.
   - Place a check next to "yes" or "no" to indicate if a preservative was added.
   - Under "analyses", place a check next to the parameters for which the sample is to be analyzed. If the desired analysis is not listed, write it in the empty slot. Note: Do not write in the box for "laboratory sample number".

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5.3 Sample Shipping

CDM Federal's Standard Operating Procedure 2-5: Packaging and Shipping of Environmental Samples establishes a uniform method for packaging and shipping low level environmental samples.

6.0 RESTRICTIONS/LIMITATIONS

For EPA CLP sampling events, combined chain-of-custody/traffic report forms will be utilized. Refer to Regional guidelines for completing these forms.

7.0 REFERENCES

U.S. Environmental Protection Agency, *A Compendium of Superfund Field Operations Methods*, EPA/540/P-87/001, December 1987.

U.S. Environmental Protection Agency, *Samplers Guide to the Contract Laboratory Program*, EPA/540/P-90/006, December 1990.

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Figure 1
EXAMPLE CDM Federal Chain-of-Custody Record

CDM FEDERAL PROGRAMS CORPORATION
A Subsidiary of Camp Dresser & McKee Inc.

98 North Washington Street, Suite 200
Boston, MA 02114
617-742-2659

CHAIN OF CUSTODY RECORD

PROJECT NO. 11	FIELD TEAM LEADER 12	LABORATORY AND ADDRESS 13	RECORD OF 14
PROJECT NAME/LOCATION 15			AIRBILL NO. 16

SAMPLE TYPES 17
1. SURFACE WATER
2. GROUNDWATER
3. LEACHATE
4. PRIMATE
5. SOIL/SEDIMENT
6. OIL
7. WASTE
8. OTHER _____

SAMPLE NO.	SAMPLE TYPE	19 DATE	TIME SAMPLED	COMP	GRAB	SAMPLER(S) INITIALS*	PARAMETERS DESIRED (Use no. of containers indicated)	ANALYSES	REMARKS (Note # @ SAMPLE)	PRESERVATIVES ADDED (1. HCl 2. HNO3 3. H2SO4 4. NaOH 5. Ice only 6. Not Preserved 7. Other ____)
18	19	110	111	-1	2-	113	114		115	116

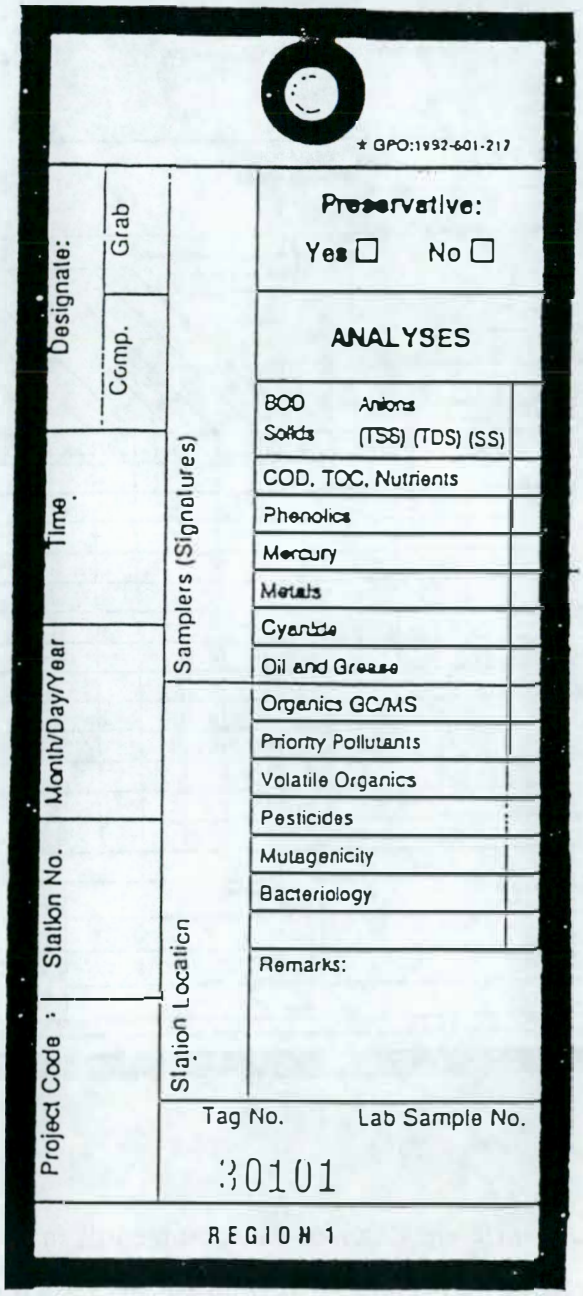
* SAMPLER SIGNATURES: 117

RELINQUISHED BY: (print) 118	DATE/TIME	RECEIVED BY: (print) 119	RELINQUISHED BY: (print)	DATE/TIME	RECEIVED BY: (print)
(sign)		(sign)	(sign)		(sign)
RELINQUISHED BY (print)	DATE/TIME	RECEIVED BY: (print)	RELINQUISHED BY: (print)	DATE/TIME	RECEIVED BY: (print)
(sign)		(sign)	(sign)		(sign)

DISTRIBUTION: White and yellow copies accompany sample shipment to laboratory, yellow copy returned by laboratory. Pink copy retained by samplers (10-92)

NOTE: If requested by the client, different Chain-of-Custody records may be used. Copies of the template for this record may be obtained from the Fairfax Graphics Department.

Figure 2
EXAMPLE EPA CLP Sample Tag



NOTE: If requested by the client, different sample tags may be used.

SUBSURFACE SOIL SAMPLING

Prepared: [illegible] 2/24/92 Signature/Date
Technical Review: [illegible] 6/24/92 Signature/Date
QA Review: [illegible] 6/29/92 Signature/Date
Approved: [illegible] Signature/Date
Issued: [illegible] 7/2/92 Signature/Date

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1.0 OBJECTIVE

The objective of this standard operating procedure (SOP) is to define the techniques and requirements for collecting soil samples from the unconsolidated zone. Techniques include use of hand augers, Shelby tubes, and split-spoon samplers.

2.0 BACKGROUND

2.1 Definitions

Unconsolidated Zone - The layer of soil above bedrock which exists in a relatively loose state.

Hand Auger - A stainless steel cylinder (bucket) approximately 3 to 4 inches in diameter and one foot in length, open at both ends with the bottom edge designed to twist into the soil and cut out a soil core. The bucket collects the soil sample. The auger has a T-shaped handle (for hand operation) attached to the top of the bucket by extendable stainless steel rod(s).

Shelby Tube - A cylindrical sampling device, generally made of brass, which is driven into the subsurface soil through the hollow-stem auger. The tube, once retrieved, may be capped and the undisturbed soil sample extruded in the laboratory prior to analysis.

Split-Spoon - A cylindrical sampling device, generally made of stainless steel, which fits into a hollow stem auger. The spoon is hinged lengthwise, which allows the sample to be retrieved by opening ("splitting") the spoon.

Subsurface Soil - The soil which exists deeper than approximately one foot (30 cm) from the surface, but above bedrock or any other consolidated material.

Grab Sample - A discrete portion or aliquot taken from a specific location at a given point in time.

Composite Sample - Two or more subsamples taken from a specific media and site at a specific point in time. The subsamples are collected and mixed, then a single average sample is taken from the mixture.

Auger Flight - A stainless steel section length attached to an auger to extend the auger as coring depth increases.

2.2 Discussion

Shallow subsurface soil samples (to depths between 1 to 10 feet) may be collected using hand augers. However, soil samples collected with a hand auger are commonly of poorer quality than those collected by split-spoon or Shelby tube samplers since the soil sample is disturbed in the augering process. Split-spoon and Shelby tube liners may be used to prevent loss of volatile organic compounds (VOCs).

2.3 Associated Procedures

- FPC SOP 1-2, Sample Custody
- FPC SOP 2-3, Composite Sample Preparation
- FPC SOP 2-5, Packaging and Shipping of Environmental Samples
- FPC SOP 3-5, Lithologic Logging
- FPC SOP 4-5, Field Equipment Decontamination

3.0 RESPONSIBILITIES

Site Manager - The Site Manager is responsible for ensuring that field personnel are trained in the use of this procedure and the required equipment, and for ensuring that subsurface soil samples are collected in accordance with this procedure and any other SOPs pertaining to specific media sampling.

Field Team Leader - The Field Team Leader is responsible for ensuring that field personnel collect subsurface soil samples in accordance with this SOP and other relevant procedures.

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4.0 REQUIRED EQUIPMENT

4.1 General

- Site-specific plans
- Field logbook
- Indelible black ink pens and markers
- Labels and appropriate forms/documentation for sample shipment
- Appropriate sample containers
- Insulated cooler(s) and waterproof sealing tape
- Ice bags or "blue ice"
- Latex or appropriate gloves
- Plastic zip-top bags
- Personal protective clothing and equipment
- Stainless steel and/or Teflon-lined spatulas and pans, trays, or bowls
- Plastic sheeting

4.2 Manual (Hand) Augering

- Hand auger: flighted-, bucket-, or tube-type auger as required by the site-specific plans
- Extension rods, as needed
- Wrench(es), pliers

4.3 Split-Spoon and Shelby Tube Sampling

- Drill rig equipped with a 140-lb drop hammer and sufficient hollow-stem augers to drill to the depths required by the site-specific plans
- Sufficient numbers of split-spoon or Shelby tube samplers so that a least one is always decontaminated and available for sampling. Three split-spoon or Shelby tube samplers are generally the minimum necessary. (Shelby tubes are usually used only once.)
- Teflon split-spoon or Shelby tube liners, as appropriate

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5.0 PROCEDURES

5.1 Preparation

1. Don the appropriate personal protective clothing as dictated by the site-specific health and safety plan.

2. The collection points shall be stated, located on a site map, and referenced in the field logbook.

3. Processes for verifying depth of sampling must be specified in the site-specific plans.

4. Clear away vegetation and debris from the surface at the boring location.

5. Prepare an area next to the sample collection location for laying out cuttings by placing plastic sheeting on the ground or over a work area.

6. Set up a decontamination line, if decontamination is required. See FPC SOP 4-5.

5.2 Collection

The following general steps must be followed when collecting all subsurface soil samples:

1. VOC samples or samples degraded by aeration shall be collected first and with the least disturbance possible. These samples shall be collected as grab samples.

2. Sampling information shall be recorded in the field logbook and on any associated forms. Describe lithology, according to FPC SOP 3-5, in the field logbook or on the Lithologic Log Form.

3. Specific sampling devices to be used shall be identified in the site-specific plans.

4. Care must be taken to prevent cross-contamination and misidentification of samples.

5. Processes for verifying depth of sampling must be specified in the site-specific plans.

6. Sample bottles for VOC analysis should be filled completely.

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5.2.1 Manual (Hand) Augering

The following steps must be followed when collecting hand-augered samples:

1. Auger to the depth required for sampling. Place cuttings on plastic sheeting or as specified in the site-specific plans. If possible, lay out the cuttings in stratigraphic order.

2. Throughout the augering, make detailed notes concerning the geologic features of the soil or sediments in the field logbook.

3. Cease augering when the top of the specified sampling depth has been reached. If required, remove the auger from the hole and decontaminate the auger or use a fresh auger. Then obtain the sample.

4. Collect a grab sample for VOC analyses (or samples that may be degraded by aeration) immediately and place in sample container. Sample bottles should be filled completely.

5. Label the sample container with the appropriate information. Secure the label, covering it with a piece of clear tape.

6. Any remaining sample may be mixed, according to FPC SOP 2-3, for other analyses prior to placing samples in the appropriate containers.

7. Wipe containers clean with a clean Kimwipe or paper towel.

8. Place the containers in zip-top plastic bags and seal the bags. Pack samples in a chilled cooler.

9. Proceed with further sampling, as required by the site-specific plans.

10. When all sampling is complete, dispose of cuttings, plastic sheeting, etc. as specified in the site-specific plans.

11. Complete the field logbook entry and other appropriate forms being sure to record all relevant information before leaving the site.

12. Properly package all samples for shipment and complete all necessary sample shipment documentation. Remand custody of samples to the appropriate personnel. See FPC SOPs 1-2 and 2-5 or site-specific plans.

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5.2.2 Manual (Hand) Augering Using a Tube Sampler With Liner

The following steps must be followed when collecting hand-augered samples using a tube sampler with liner:

1. Auger to the depth required for sampling. Place cuttings on the plastic sheeting as specified in the site-specific plans. If possible, lay out the cuttings in stratigraphic order.

2. Throughout augering, make detailed notes concerning the geologic features of the soil or sediments in the field logbook.

3. Cease augering when the top of the specified sampling depth has been reached. Remove the auger from the hole and decontaminate.

4. Prepare a decontaminated tube sampler by installing a decontaminated Teflon liner in the auger tube.

5. Obtain the sample and retrieve the auger. Remove the liner and sample from the tube and immediately cap the ends of the tube. Seal the caps with waterproof tape.

6. Label the sealed liners as required in the site-specific plans. Mark the top and bottom of the sample on the outside of the liner. Indicate boring/well number and depth on outside of liner.

7. Wipe sealed liners clean with a clean Kimwipe or paper towel.

8. Place sealed liners in zip-top plastic bags and seal the bags. Pack samples in a chilled cooler.

9. Proceed with further sampling, as required by the site-specific plans.

10. When sampling is complete, dispose of cuttings, plastic sheeting, etc. as specified in the site-specific plans.

11. Decontaminate all equipment according to FPC SOP 4-5.

12. Complete the field logbook entry and other forms being sure to record all relevant information before leaving the site.

13. Properly package all samples for shipment and complete all necessary sample shipment documentation. Remand custody of samples to the appropriate personnel. See FPC SOPs 1-2 and 2-5 or site-specific plans.

5.2.3 Split-Spoon Sampling

The following steps must be followed when collecting split-spoon samples:

1. Remove any pavement and subbase material from an area of twice the bit diameter, if necessary.

2. The drilling rig will be decontaminated at a separate location prior to drilling, per the site-specific decontamination procedures.

3. Attach to the drill rig the hollow-stem auger with the cutting head, plug and center rod(s).

4. Begin drilling and proceed to the first designated sample depth, adding auger flight(s) as necessary.

5. Slightly raise the auger flight(s) to disengage the cutting head, and rotate the auger without advancement to clean cuttings from the bottom of the hole.

6. Remove the plug and center rods.

7. Install a decontaminated split spoon on the center rod(s) and insert it into the hollow-stem auger. Connect the hammer assembly and lightly tap the rods to seat the drive shoe at the top of undisturbed soil or sediment.

8. Mark the center rod in 6-inch increments from the top of the auger flight(s).

9. Drive the spoon using the hammer. Use a full 30-inch drop as specified by the American Society for Testing and Materials (ASTM) Method D-1586. Record the number of blows required to drive the spoon or tube through each 6-inch increment.

10. Cease driving when the full length of the spoon has been driven or upon refusal. Refusal occurs when little (< 1 inch) or no progress is made for 50 blows of the hammer.

11. Pull the spoon or tube free by using upswings of the hammer to loosen the sampler. Pull out the center rod and spoon or tube.

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12. Unscrew the split-spoon assembly from the center rod and place it on the plastic sheeting.

13. Remove the drive shoe and head assembly. If necessary, tap the split-spoon assembly with a hammer to loosen threaded couplings.

14. With the drive shoe and head assembly off, open (split) the spoon, being careful not to disturb the sample.

15. Label sample containers with appropriate information. Secure the label covering it with a piece of clear tape.

16. If VOC analyses are to be conducted on the soil sample, place that sample in its sample container immediately after opening the spoon, filling the sample bottle completely. Seal the container immediately, then describe it in the field logbook and/or associated forms. Record the sample identification number, depth from which the sample was taken and the analyses to be performed on the samples in the field logbook and on the appropriate forms.

17. Any remaining sample may be mixed according to FPC SOP 2-3 prior to placing samples in appropriate containers.

18. Wipe containers clean with a clean Kimwipe or paper towel.

19. Place containers in zip-top plastic bags and seal the bags. Pack samples in a chilled cooler.

20. Continue to advance the borehole to the next sampling point. Collect samples as outlined above.

21. When sampling is complete, remove the drilling rig to the heavy equipment decontamination area.

22. Dispose of cuttings, plastic sheeting, etc. as specified in the site-specific plans.

23. Decontaminate split spoons and other small sampling equipment according to FPC SOP 4-5 before proceeding to other sampling locations.

24. Complete the field logbook entry and other forms, being sure to record all relevant information before leaving the site.

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25. Properly package all samples for shipment to laboratories and complete all necessary sample shipment documentation. Remand custody of the samples to the appropriate personnel. See FPC SOPs 1-2 and 2-5 or site-specific plans.

5.2.4 Split-Spoon Sampling Using Liners

The following steps must be followed when collecting samples with lined split spoons:

1. Remove any pavement and subbase material from an area of twice the bit diameter, if necessary.

2. The drilling rig will be decontaminated at a separate location prior to drilling.

3. Attach the hollow-stem auger with the cutting head and center rod(s).

4. Begin drilling and proceed to the first designated sample depth, adding auger flight(s) as necessary.

5. Slightly raise the auger flight(s) to disengage the cutting head, and rotate the auger without advancement to clean cuttings from the bottom of the hole.

6. Remove the plug and center rods.

7. Install a decontaminated Teflon or stainless steel liner in the split-spoon barrel.

8. Install a decontaminated split spoon on the center rod(s) and insert it into the hollow-stem auger. Connect the hammer assembly and lightly tap the rods to seat the drive shoe at the top of undisturbed soil or sediment.

9. Mark the center rod in 6-inch increments from the top of the auger flight(s).

10. Drive the spoon using the hammer. Use a full 30-inch drop as specified by ASTM Method D-1586. Record the number of blows required to drive the spoon or tube through each 6-inch increment.

11. Cease driving when the full length of the spoon has been driven or upon refusal. Refusal occurs when little (< 1 inch) or no progress is made after 50 blows of the hammer.

12. Pull the spoon or tube free by using upswings of the hammer to loosen the sampler. Pull out the center rod and spoon or tube.

13. Unscrew the split-spoon assembly form the center rod and place it on the plastic sheeting.

14. Remove the drive shoe and head assembly. If necessary, tap the split-spoon assembly with a hammer to loosen threaded couplings.

15. With the drive shoe and head assembly off, open (split) the spoon and remove the liners without disturbing the sample.

16. Immediately install a Teflon septa over the ends of the liners, cap the septa, and seal the caps over the ends of the liner with waterproof tape. Label the samples as required by the site-specific plans. Mark the top and bottom of the sample on the outside of the liner. Indicate boring/well number and depth on outside of liner.

17. Wipe sealed liners clean with a clean Kimwipe or paper towel.

18. Place sealed liners in zip-top plastic bags and seal the bags. Pack samples in a chilled cooler.

19. In the field logbook and on the boring log, describe sample lithology by observing cuttings and the bottom end of the sample in the liner.

20. Continue to advance the borehole to the next sampling point. Collect samples as outlined above.

21. When sampling is complete, remove the drilling rig to the heavy equipment decontamination site.

22. Dispose of cuttings, plastic sheeting, etc. as specified in the site-specific plans.

23. Decontaminate split spoons and other small sampling equipment before proceeding to other sampling locations as required by the site-specific plans.

24. Complete the field logbook entry, and other forms, being sure to record all relevant information before leaving the site.

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25. Properly package all samples for shipment to laboratories and complete all necessary sample shipment documentation. Remand custody of the samples to the appropriate personnel. See FPC SOPs 1-2 and 2-5 or site-specific plans.

5.2.5 Shelby Tube Sampling

The following steps must be followed when collecting samples using the Shelby tube:

1. Remove any pavement and subbase material from an area of twice the bit diameter, if necessary.

2. The drilling rig will be decontaminated at a separate location prior to drilling.

3. Attach the hollow-stem auger with the cutting head, plug, and center rod(s).

4. Begin drilling and proceed to the first designated sample depth, adding auger flight(s) as necessary.

5. Slightly raise the auger flight(s) to disengage the cutting head, and rotate the auger without advancement to clean cuttings from the bottom of the hole.

6. Remove the plug and center rods.

7. Attach a head assembly to a decontaminated Shelby tube. Attach the Shelby tube assembly to the center rods.

8. Lower the Shelby tube and center rods into the hollow-stem augers and seat it at the bottom. Be sure to leave 30 inches or more of center rod above the lowest point to the hydraulic piston's extension.

9. Use the rig's hydraulic drive to push the Shelby tube into undisturbed soil. The tube should be pushed with a steady force.

10. When the Shelby tube has been advanced its full length or to refusal, back off the hydraulic pistons. Attach a hoisting plug to the upper end of the center rod, twist to break off the sample, and pull the apparatus out of the hole with the rig winch.

11. Retrieve the Shelby tube to the surface, detach it from the center rod, and remove the head assembly.

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12. Use a hydraulic extruder to extrude the sample from the tube onto a clean piece of plastic sheeting unless the sample is for engineering purposes (see Step 18).

13. Label sample containers with appropriate information. Secure the label covering it with clear tape.

14. If VOC analyses are to be conducted on the soil sample, collect a grab sample immediately after extruding the samples. Place VOC sample in the appropriate container, fill completely, and seal immediately, then describe it in the field logbook and boring log. Record the sample identification number, depth from which the sample was taken and the analyses to be performed on the samples in the field logbook and on the appropriate forms.

15. Any remaining sample may be mixed according to FPC SOP 2-3 prior to placing samples in the appropriate containers.

16. Wipe sealed tubes clean with a clean Kimwipe or paper towel.

17. Place sealed tubes in zip-top plastic bags and seal bags. Pack samples in a chilled cooler.

18. If the intent of the Shelby tube sampling is for engineering purposes and an undisturbed sample is required, the tube ends should be sealed immediately, the top and bottom ends of the tube marked, and the tube should be transported to the laboratory in an upright position. Indicate boring/well number and depth on outside of liner.

19. Continue to advance the borehole to the next sampling point. Collect samples as outlined above.

20. When sampling is complete, remove the drilling rig to the heavy equipment decontamination area.

21. Dispose of cuttings, plastic sheeting, etc. as specified in the site-specific plans.

22. Decontaminate Shelby tubes and other small sampling equipment before proceeding to other sampling locations as required by the site-specific plans.

23. Complete the field logbook entry, being sure to record all relevant information before leaving the site.

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6.0 RESTRICTIONS/LIMITATIONS

Basket or spring retainers may be needed for split-spoon sampling in loose, sandy soils.

Shelby tubes may not retain the sample in loose, sandy soils.

7.0 REFERENCES

American Society for Testing and Materials, *Penetration Test And Split Barrel Sampling Of Soils*, Standard Method D-1586-84, 1984.

U.S. Department of Energy, Hazardous Waste Remedial Actions Program, *Quality Control Requirements For Field Methods*, DOE/HWP-69/R1, July 1990.

U.S. Department of Energy, Hazardous Waste Remedial Actions Program, *Standard Operating Procedures For Site Characterizations*, DOE/HWP-100, July 1990.

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PACKAGING AND SHIPPING OF ENVIRONMENTAL SAMPLES

Prepared: Keith E. Owens 12/31/92 Signature/Date

Technical Review: [illegible] 1-4-93 Signature/Date

QA Review: Teresa Nelis 1/4/93 Signature/Date

Approved: [illegible] 3/11/93 Signature/Date

Issued: Rose Mary Ellesick 4/22/93 Signature/Date

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1.0 OBJECTIVE

The objective of this standard operating procedure (SOP) is to establish packaging and shipping requirements and guidelines for environmental sample shipping.

2.0 BACKGROUND

2.1 Definitions

Environmental Sample - Environmental Sample is any sample that has less than reportable quantities for any hazardous constituents according to Department of Transportation (DOT) 49 CFR - Section 172.

2.2 Discussion

Proper packaging and shipping is necessary to ensure the protection of the integrity of environmental samples shipped for analysis.

2.3 Associated Procedures

- CDM Federal SOP 1-2, Sample Custody
- CDM Federal SOP 2-4, Packaging and Shipping Hazardous Samples

3.0 RESPONSIBILITIES

Field Team Leader - The Field Team Leader is responsible for ensuring that packaging and sampling procedures are conducted in accordance with this SOP. The Field Team Leader is also responsible for ensuring that laboratory analysis of samples is properly coordinated by CDM Federal.

4.0 REQUIRED EQUIPMENT

- Coolers with return address of CDM Federal office written on inside lid
- Heavy-duty plastic bags
- Plastic zip-top bags, small and large
- Plastic electrical tape
- Fiber tape
- Duct tape
- Vermiculite and/or packing peanuts
- Bubble wrap (optional)
- Ice
- Chain-of-Custody seals
- Completed Chain-of-Custody record or CLP custody records if applicable
- Completed Bill of Lading

5.0 PROCEDURES

The following steps must be followed when packing for shipment by air:

1. Select a sturdy cooler in good repair. Secure and tape the drain plug with fiber or duct tape. Line the cooler with a large heavy-duty plastic bag.

2. Be sure the caps on all bottles are tight (will not leak); check to see that labels and chain-of-custody records are completed properly.

3. Place all bottles in separate and appropriately sized plastic zip-top bags and close the bags. Up to three VOA vials may be packed in one bag. Bottles may be wrapped in bubble wrap. Optional, place three to six VOA vials in a quart metal can and then fill the can with vermiculite. It is preferable to place glass sample bottles and jars into the cooler vertically. Due to the strength properties of a glass container, there is much less chance for breakage when the container is packed vertically rather than horizontally.

4. Place two to four inches of packing peanuts or vermiculite into the bag in the cooler and then place the bottles and cans in the bag with sufficient space to allow for the addition of more packing peanuts or vermiculite between the bottles and cans.

5. Put ice in large plastic zip-top bags (double bagging the zip-tops is preferred) and properly seal. Place these ice bags on top of, or between, the samples. Fill all remaining space between the bottles or cans with packing peanuts or vermiculite. Securely fasten the top of the large garbage bag with tape (preferably duct tape).

6. Place the completed Chain-of-Custody Record or the CLP Traffic Report Form (if applicable) for the laboratory into a plastic zip-top bag, tape the bag to the inner side of the cooler's lid, and then close the cooler.

7. Fiber tape shall be wrapped around each end of the cooler two times, and completed Chain-of-Custody seals affixed to the top opposite sides of the cooler half on the fiber tape so that the cooler cannot be opened without breaking the seal. Complete two more wrap arounds with fiber tape; place clear tape over custody seals.

8. The shipping containers must be marked "THIS END UP" and arrow labels which indicate the proper upward position of the container should be affixed to the cooler. A label containing the name and address of the shipper shall be placed on the outside of the container. Labels used in the shipment of hazardous materials (such as Cargo Only Air Craft, Flammable Solids, etc.) are not permitted to be on the outside of the container used to transport environmental samples and shall not be used.

6.0 RESTRICTIONS/LIMITATIONS

The holding times for the samples packed for shipment must not be exceeded. Samples should be packed in time to be shipped nightly for overnight delivery. Use caution when shipping samples for weekend delivery; contact laboratory before sending samples.

7.0 REFERENCES

U.S. Environmental Protection Agency, *Sampler's Guide to the Contract Laboratory Program*, EPA/540/P-90/006, December 1990.

U.S. Environmental Protection Agency, Region IV, *Standard Operating Procedures and Quality Assurance Manual*, February 1991.

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FIELD LOGBOOK CONTENT AND CONTROL

Prepared: 6/26/92 Signature/Date

Technical Review: 6/26/92 Signature/Date

QA Review: 6/30/92 Signature/Date

Approved: Signature/Date

Issued: 7/1/92 Signature/Date

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1.0 OBJECTIVE

The objective of this standard operating procedure (SOP) is to set CDM Federal Programs Corporation (FPC) company-wide criteria for content entry and form of field logbooks.

2.0 BACKGROUND

2.1 Definitions

Biota - The flora and fauna of a region.

Decontamination - To remove contaminants from field sampling equipment that might bias analytical results.

Magnetic Declination Corrections - Compass adjustments to correct for the angle between magnetic north and geographical meridians.

2.2 Discussion

Information recorded in field logbooks include observations, data, calculations, time, weather, description of the data collection activity, methods, instruments, and results. Additionally, the logbook may contain descriptions of wastes, biota, geologic material, and site features including sketches, maps, or drawings as appropriate.

3.0 RESPONSIBILITIES

Field Team Leader (FTL) - The FTL is responsible for ensuring the nature and form of data entries are conducted in accordance with this procedure.

Site Personnel - All FPC employees who make entries in field logbooks during on-site activities are required to read this procedure prior to engaging in this activity. The FTL will assign field logbooks to site personnel who will be responsible for their care and maintenance.

4.0 REQUIRED EQUIPMENT

- Site-specific plans
- Field notebook
- Indelible black ink pen
- Ruler or similar scale (in some circumstances)

5.0 PROCEDURES

5.1 Preparation

In addition to this SOP, site personnel responsible for maintaining logbooks must be familiar with other pertinent FPC and site SOPs. These should be consulted as necessary to obtain specific information about equipment and supplies, health and safety, sample collection, packaging, decontamination, and documentation. These procedures should be located at the field office.

Prior to use in the field, each logbook will be marked with a specific document control number issued by the document control administrator. The field notebook will then be assigned to an individual responsible for its care and maintenance.

Field logbooks shall be bound with lined, consecutively numbered pages. All pages must be numbered prior to initial use of the logbook. The following information shall be recorded inside the front cover of the logbook:

- Field Logbook Document Control Number
- Activity (if the logbook is to be activity-specific)
- Person and organization to whom the book is assigned, and phone number(s)
- Start date

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The first five pages of the logbook shall be reserved for a table of contents. Mark the first page with the heading and enter the following:

TABLE OF CONTENTS

Date/Description	Page
(Start Date)/Reserved for TOC	1-5

The remaining pages of the Table of Contents will be designated as such with "TOC" written on the top center of each page.

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5.2 Operation

The following is a list of requirements that must be followed when using a logbook:

- Record work, observations, quantities of materials, calculations, drawings, and related information directly in the logbook. If data-collection forms are specified by an activity-specific plan, this information need not be duplicated in the logbook. However, any forms used to record site information must be referenced in the logbook.
- Do not start a new page until the previous one is full or has been marked with a single diagonal line so that additional entries cannot be made. Use both sides of each page.
- Do not erase or blot out any entry at any time. Before an entry has been signed and dated, changes may be made but care must be taken not to obliterate what was written originally. Indicate any deletion by a single line through the material to be deleted.
- Do not remove any pages from the book.
- Record as much information as possible.

Specific requirements for field logbook entries include:

- Initial and date each page
- Sign and date the final page of entries for each day
- Initial and date all changes

- Multiple authors must sign out the logbook by inserting the following:

  Above notes authored by:
  - (Sign name)
  - (Print name)
  - (Date)

- A new author must sign and print his/her name before additional entries are made
- Draw a diagonal line through the remainder of the final page at the end of the day
- Record the following information on a daily basis:

  - Date and time
  - Name of individual making entry
  - Description of activity being conducted including station (i.e. well, boring, sampling location number) if appropriate
  - Weather conditions (i.e. temperature, cloud cover, precipitation, wind direction, and speed) and other pertinent data
  - Level of personnel protection to be used

Entries into the field logbook shall be preceded with the time (written in military units) of the observation. The time should be recorded frequently and at the point of events or measurements that are critical to the activity being logged. All measurements made and samples collected must be recorded unless they are documented by automatic methods (e.g. data logger) or on a separate form required by an operating procedure. In these cases, the logbook must reference the automatic data record or form.

At each station where a sample is collected or an observation or measurement made, a detailed description of the location of the station is required. Use a compass (include a reference to magnetic declination corrections), scale, or nearby survey markers, as appropriate. A sketch of station location may be warranted. All maps or sketches made in the logbook should have descriptions of the features shown and a direction indicator. It is preferred that maps and sketches be oriented so that north is towards the top of the page.

Other events and observations that should be recorded include:

- Changes in weather that impact field activities

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- Deviations from procedures outlined in any governing documents. Also record the reason for any noted deviation.
- Problems, down-time, or delays
- Upgrade or downgrade of personnel protection equipment

5.3 Post-Operation

To guard against loss of data due to damage or disappearance of logbooks, copies of completed pages shall be periodically (weekly, at a minimum) and securely stored at the field office. Documents which are separated from the logbook shall be copied and submitted regularly and as promptly as possible to the field office. This includes all automatic data recording media (print-outs, logs, disks or tapes) and activity-specific data collection forms required by other SOPs.

At the conclusion of each activity or phase of site work, the individual responsible for the logbook will ensure all entries have been appropriately signed and dated, and that corrections were made properly (single lines drawn through incorrect information, then initialed and dated). The completed logbook shall be submitted to the field office records file.

6.0 RESTRICTIONS/LIMITATIONS

Field logbooks constitute the official record of on-site technical work, investigations, and data collection activities. Their use, control, and ownership is restricted to activities pertaining to specific field operations carried out by CDM FPC personnel and their subcontractors. They are documents that may be used in court to indicate and defend dates, personnel, procedures, and techniques employed during site activities. Entries made in these notebooks should be factual, clear, precise, and as non-subjective as possible. Field logbooks, and entries within, are not to be utilized for personal use.

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7.0 REFERENCES

Sandia National Laboratories. 1991. *Procedure for Preparing, Sampling and Analysis Plan, Site-Specific Sampling Plan, and Field Operating Procedures*, QA-02-03. Albuquerque Environmental Program Department 3220. Albuquerque, New Mexico.

Sandia National Laboratories. 1992. Division 7723. *Field Operation Procedure for Field Logbook Content and Control*. Environmental Restoration Department. Albuquerque, New Mexico.

CONTROL OF MEASUREMENT AND TEST EQUIPMENT

SOP 5-1
Revision: 1
Date: November 1, 1993

Prepared: 10/29/93 Signature/Date
Technical Review: 10/29/93 Signature/Date
QA Review: 10/29/93 Signature/Date
Approved: 10/29/93 Signature/Date
Issued: 11/1/93 Signature/Date

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1.0 OBJECTIVE

The objective of this standard operating procedure is to establish the baseline requirements, procedures and responsibilities inherent to the control and use of all measurement and test equipment.

2.0 BACKGROUND

2.1 Discussion

To ensure the accuracy of M&T results, M&TE purchased for CDM Federal corporate use and government furnished M&TE purchased or acquired through transfer, must be utilized in full compliance with the requirements for:

- Preparing and attaching Equipment Procedures and Equipment Logs
- Shipment
- Record keeping
- The traceability of calibration standards
- Removing an item of M&TE from use if it cannot be calibrated or adjusted to perform accurately

M&TE leased or rented through outside vendors must be utilized in full compliance with the requirements stated above with the exception that Equipment Procedures and Equipment Logs will not be prepared or attached. Rented or leased M&TE must be used in accordance with the manufacturer's operating, maintenance and calibration procedures.

2.2 Definitions

EC - Equipment Coordinator

EL - Equipment Log

EP - Equipment Procedure

ESCM - Equipment Service Center Manager

EWM - Equipment Warehouse Manager

Field Check - The reading obtained prior to and after actual use in the field.

M&TE - Measurement and test equipment

M&T - Measurement and testing

M&C - Maintenance and calibration

Traceability - The ability to trace the history, application, or location of an item and like items or activities by means of recorded identification.

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2.3 Associated Procedures

- CDM Federal Equipment Procedures (EPs)
- Manufacturer's operating, maintenance and calibration procedures

3.0 RESPONSIBILITIES

All staff with responsibility for the control of M&TE and all users of M&TE are responsible for implementing the requirements contained herein.

3.1 M&TE Users Responsibilities

- Follow the EPs when using CDM Federal corporate M&TE and government furnished M&TE
- Specify that the manufacturer's operating, maintenance and calibration procedures are included when renting or leasing M&TE from outside vendors and follow those procedures during M&TE use
- Use calibration standards traceable to nationally recognized standards.
- Ensure that measurements are valid by checking post run calibration or field checks
- Make proper entries into the Equipment Log and document the calibration, use and service of the equipment
- Make proper entries into the Field Log as specified in the project-specific controlling documents
- Make photocopies of the Equipment Log pages and send them to the ESCM, EWM or EC as appropriate

3.2 ESCM Responsibilities

With the exception of M&TE rented or leased from outside vendors, the ESCM shall obtain the manufacturer's operating, maintenance and calibration procedures and prepare and attach, or direct the attachment of, Equipment Procedures and Equipment Logs to M&TE shipping cases. For M&TE for which the ESCM is directly responsible, the ESCM shall also:

- Label items of M&TE requiring calibration
- Affix a calibration label on M&TE calibrated by them
- Ensure that M&TE is maintained as required
- Ensure that M&TE is calibrated to standards traceable to nationally recognized standards

- Consume or dispose of standards on or before the expiration date
- Maintain M&TE records
- Periodically review M&TE records and report all non-conforming items and take appropriate corrective action as required

3.3 EWM and EC Responsibilities

For M&TE for which the EWM and EC are directly responsible, the EWM and the EC shall:

- Label items of M&TE requiring calibration
- Affix a calibration label on M&TE calibrated by them
- Maintain M&TE records
- Ensure that M&TE is maintained as required
- Ensure that M&TE is calibrated to standards traceable to nationally recognized standards
- Consume or dispose of standards on or before the expiration date
- Periodically review M&TE records and report all non-conforming items and take appropriate corrective action as required

4.0 REQUIREMENTS

With the exception of M&TE rented from outside vendors, M&TE shall not be used unless an Equipment Procedure and an Equipment Log have been established and attached to the shipping case of the item. M&TE rented or leased from outside vendors shall be operated, maintained and calibrated in accordance with the manufacturer's procedures. Calibration status shall be identified on M&TE.

4.1 Prepare and Attach an Equipment Procedure

With the exception of M&TE rented or lease from outside vendors, each M&T instrument shall have an EP. Some or all of the following information, as appropriate to the M&TE, will be included:

- Applications
- Calibration standards
- Calibration frequency
- Initial calibration tolerance
- Post run calibration tolerance
- Calibrated instrument range
- Field check frequency
- Field check acceptance range
- Maintenance frequency
- Measurement type
- Safety considerations
- Limitations of use
- Interferences
- Start-up procedure
- Operating procedure

- Shutdown procedure
- Field check procedure
- Field calibration procedure
- Field maintenance procedure
- ESC calibration procedure
- ESC maintenance procedure

The EP provides the instrument-specific information to ensure that the M&TE is calibrated, used and maintained according to the proper written procedure.

4.2 Prepare and Attach an Equipment Log

With the exception of M&TE rented or leased from outside vendors, each M&T instrument must have an EL. The following items will be entered into the EL each time the equipment is serviced or calibrated:

- The date
- The time of the entry
- The name of the item of M&TE
- The serial number and Property Control Number (if applicable) of the item of M&TE
- The name of the person making the entries
- The project number
- The description of activity (or project)
- The calibration standard used
- The concentration of the calibration standard
- The lot number of the calibration standard
- The expiration of the calibration standard
- The pre-calibration reading obtained on the calibration standard
- The reading obtained on the standard after the calibration or maintenance is performed
- Any notable incidents that may contribute to the proper calibration, repair or decontamination of the instrument
- The date and signature of the person making the entries after the final entry.

The EL provides documentation that the M&TE was calibrated and/or field checked in accordance with the EP. When M&TE that is rented or leased from outside vendors is serviced or calibrated, that information will be recorded in the Field Log as specified in the project-specific controlling documents.

4.3 Label M&TE Requiring Calibration

Items of M&TE that require calibration, immediately before use shall have a label affixed to them stating "Calibrate Before Use." M&TE that is calibrated at scheduled intervals shall have a calibration label attached listing the date of the calibration, date the M&TE is next due for calibration and the initials of the person performing the calibration.

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4.4 Shipment

With the exception of M&TE rented or leased from outside vendors, M&TE shall be shipped with the CDM Federal Equipment Procedure and the Equipment Log. M&TE rented or leased from outside vendors shall be shipped with the manufacturer's standard operating, maintenance and calibration procedures.

4.5 Record Keeping

With the exception of M&TE rented or leased from outside vendors, every item of M&TE shall have a complete "cradle to grave" record established and maintained. By category, the following records are to be included in each respective M&TE item file:

Operating Instructions: manufacturer's operating manual and the CDM Federal EP.

Maintenance and Calibration: all maintenance and calibration records; Equipment Log records; certifications of standards; and the receipt and expiration date of standards.

Reporting: project or service center correspondence; inventory reports; missing stolen or damage reports; excess equipment reports; non-hazardous certification (for government owned property); disposal reports; transfer reports; utilization reports; and non-conformance reports

Shipping: packing slips; air freight or other transportation shipping; and receipt documents

Miscellaneous or Invoicing: any document regarding the equipment that does not readily fit in a defined category and/or invoices for the rental of M&TE assigned to the Equipment Service Center

4.6 Traceability of Calibration Standards

M&TE requires calibration that is ultimately traceable to nationally recognized standards. This calibration may be performed by CDM Federal personnel following the calibration procedure specified in the EPs or the M&TE can be calibrated by an appropriately qualified outside source. If calibration is performed by CDM Federal, the standards used must be appropriate for the M&TE application and must be traceable to nationally recognized standards. Calibration performed by outside sources must include documentation of traceability to nationally recognized standards.

5.0 PROCEDURES

5.1 Prepare and Attach an Equipment Procedure and an Equipment Log

The following procedures must be followed whenever M&TE is purchased or received through transfer:

1. Upon the initial receipt of M&TE the recipient shall immediately notify the ESCM via telephone, EMAIL, facsimile or hard copy memorandum.

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2. The ESCM will obtain the appropriate manufacturer's operating manual and/or instructions.

3. The ESCM will prepare an EP, obtain appropriate approvals, and attach or forward the EP to the recipient directing that the procedure be attached to the shipping case.

4. The ESCM will prepare an EL, and attach or forward the EL to the recipient directing that it be attached to the shipping case.

5.2 Shipment

The following procedures are to be followed whenever M&TE is shipped:

1. With the exception of M&TE rented or leased from outside vendors, the ESCM, EWM, or EC should inspect the shipping case to ensure that the operating documentation as specified in the CDM Federal EP and the EL, is complete and included with the shipment.

2. For M&TE that is rented or leased from outside vendors, the CDM Federal staff member responsible for effecting the shipments should specify to the outside vendor that the manufacturer's operating, maintenance and calibration procedures be included with the shipment.

3. If the documents are complete and included, proceed to ship the equipment.

4. If a required document is missing or incomplete, do not ship the equipment. Immediately contact the ESCM via telephone, EMAIL, facsimile or hard copy memorandum and request new operating procedures and/or an EL.

5. If the EL is incomplete immediately contact the ESCM via telephone, EMAIL,facsimile or hard copy memorandum. The ESCM will take appropriate corrective action.

5.3 Record Keeping

The following steps must be followed when establishing and maintaining an equipment file:

1. Upon the initial receipt of M&TE through purchase or transfer create a permanent equipment file.

2. Maintain the files by item of M&TE and keep all files in a cabinet or drawer at the pertinent warehouse or office location, segregated by contract or service center origin.

3. With the exception of the Equipment Log and the manufacturers packing slip, all original documents will be included in the equipment file upon receipt.

4. Upon receipt of M&TE, the recipient shall photocopy the packing slip. The recipient shall forward the original packing slip to Accounts Payable. The recipient shall forward the photocopy to the ESCM, the EWM or the EC, whomever of these individuals is the responsible party for the item of M&TE, for inclusion in the equipment file

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5. On a weekly basis the user of M&TE shall photocopy the pages of the Equipment Log for that week of activities and forward them to the ESCM, the EWM, or the EC, whichever of those individuals is the responsible party for the item of M&TE.

5.4 Traceability of Calibration Standards

The following steps must be taken to ensure the traceability of calibration standards:

1. Calibration standards will be procured requiring certification to a nationally recognized standard.

2. Certifications of standards will be maintained in the equipment files.

3. Standards that are perishable will be noted on a schedule and consumed or disposed of on or before the expiration date.

5.5 M&TE That Fails Calibration

The following steps must be followed if an item of M&TE cannot be calibrated or adjusted to perform accurately:

1. At each instance of M&C, check the results to make sure they are within the limits specified in the manufacturer's maintenance and calibration documentation and/or the CDM Federal Equipment Procedure as appropriate.

2. If an item fails a calibration procedure the operator shall immediately notify the Project Manager for the project on which the item is being used as well as the ESCM, EWM, or EC responsible for that item of M&TE. Discontinue using the equipment until it is restored to full working order and re-calibrated.

3. The operator or person who determines an item has failed a calibration, shall report the item as a non-conforming item and take appropriate action in accordance with the quality procedure for non-conforming items in the CDM Federal Programs Corporation Quality Assurance Manual.

4. The ESCM shall review the current and previous M&C records to determine if the validity of previous M&T results could have been affected and shall notify the appropriate project manager(s) if a potential negative impact is determined.

5. The ESCM shall review the current and previous M&C records annually, or more frequently if required, to determine if problematic trends are evident. If problematic trends are evident the ESCM shall take appropriate action to mitigate the trend and shall remove the item of M&TE from service until that item of M&TE is fully operational and the problematic trend has been cured.

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6.0 RESTRICTIONS/LIMITATIONS

On an item by item basis, exemptions from the requirements of this Standard Operating Procedure may be granted by the Headquarters Administrative manager with the concurrence of appropriate Headquarters Health and Safety and/or Quality Assurance staff. All exemptions from this Standard Operating Procedure shall be documented by the Headquarters Administrative Manager and included in the equipment records.

7.0 REFERENCES

- CDM Federal Programs Corporation Quality Assurance Manual
- CDM Federal Programs Corporation Property Control Manual
- CDM Federal Programs Corporation Technical Standard Operating Procedures.

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Appendix F

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APPENDIX F

DECISION CHART FOR RESPONSE TO UNKNOWNS

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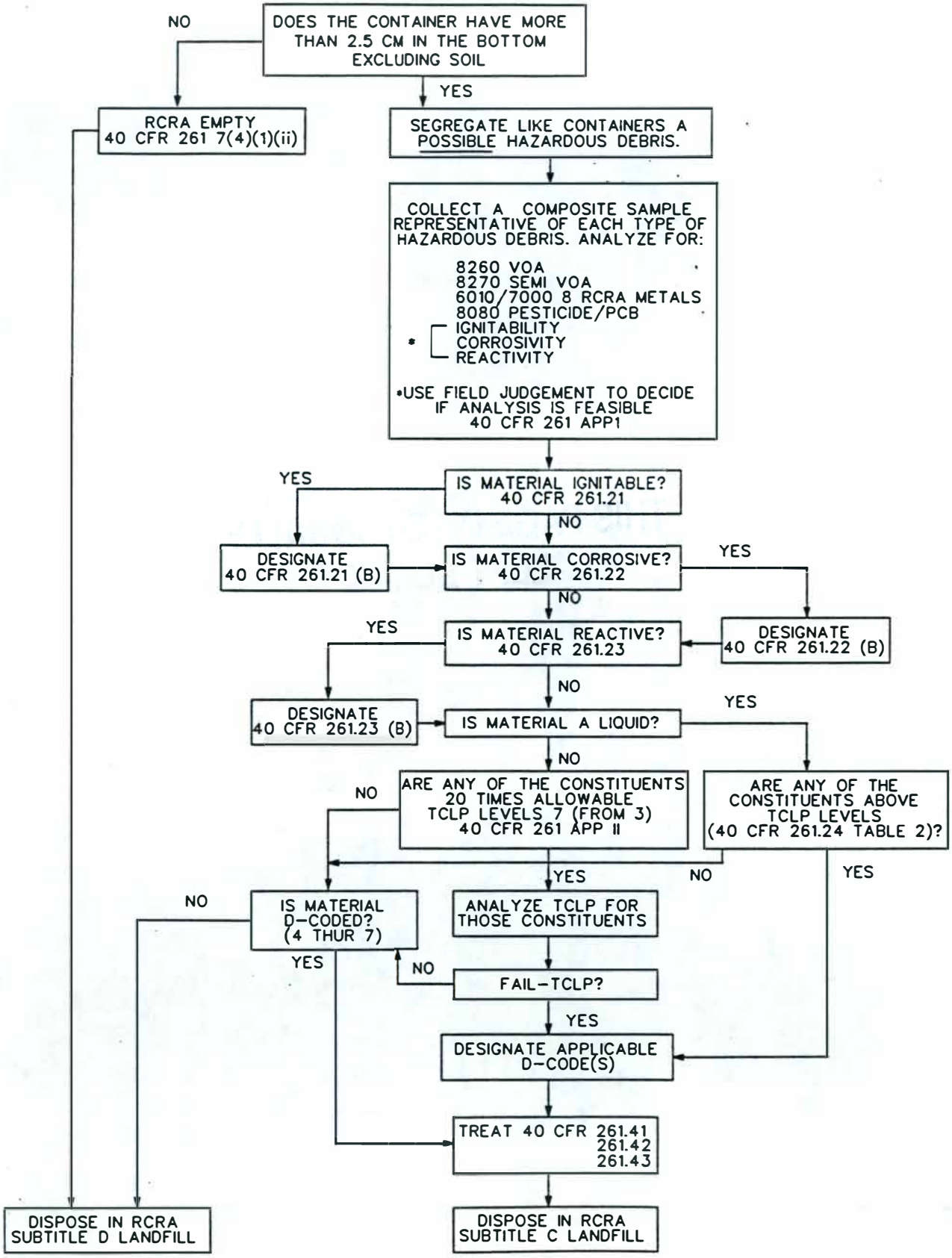
FIGURE 3-2 Handling Containers With Potentially Hazardous Materials



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APPENDIX G

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WASTE CONTROL PLAN
FOR THE NORTH SLOPE
H-06-L LANDFILL CHARACTERIZATION/REMEDIATION

1.0 INTRODUCTION

This plan presents the methods and procedures to be followed in controlling wastes generated during the H-06-L landfill characterization/remediation activities to be conducted on the North Slope of the Hanford Site. Field activities are detailed in the work plan prepared for this activity (DOE/RL-94-44). Characterization/remediation activities include: trenching in areas of the landfill where subsurface anomalies have been identified; field screening excavated materials (visually and with field instruments); segregating potentially hazardous or toxic soil and debris; staging potentially hazardous or toxic soil and debris on port-a-pads or visqueen; analyzing samples of potentially hazardous or toxic soil and debris offsite using SW-846 or CLP protocol; and arranging for offsite treatment and disposal of confirmed hazardous or toxic soil and debris. In addition, any friable (regulated) asbestos encountered during trenching activities will be disposed of at the Central Landfill Facility (CLF) asbestos disposal trench. Nonfriable (nonregulated) asbestos will be placed back into the trench excavation upon backfilling for closing.

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2.0 SCOPE

This waste control plan applies to all hazardous or toxic wastes generated during this activity. As used in this plan, hazardous or toxic waste is defined as one of the following: (1) dangerous or extremely hazardous waste as identified in WAC 173-303 - Dangerous Waste Regulations; (2) Resource Conservation and Recovery Act listed or characteristic waste; and (3) waste containing PCBs as defined by WAC 173-303 and the Toxic Substances Control Act. The waste site is considered to be the H-06-L east and west landfill areas. The majority of the hazardous or toxic waste will be a direct result of trench excavation and is expected to be contaminated soil and debris. Other wastes will include decontamination water, wastes generated by field screening techniques, and miscellaneous other wastes. These materials will be handled, transported, and treated or disposed of in accordance with the above regulations. Materials excavated from the landfill that are not classified as hazardous or toxic through field screening or offsite analyses will be backfilled into the trench excavation upon closing.

3.0 FIELD DESIGNATION/HANDLING OF WASTES

Specific procedures for handling waste generated by trenching activities are not currently covered by U.S. Army Corps of Engineers (USACE) or Westinghouse Hanford Corporation (WHC) protocols, or the Strategy for Management of Investigation Derived Waste (Ecology, EPA and DOE). This waste control plan is intended to establish protocols for this activity and when possible, will implement the requirements of established site

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protocols. Regulatory agreement will be obtained if deviations from this plan are necessary. Site specific procedures are provided below. In all cases, management of waste shall be conducted in an environmentally protective manner.

Because these activities are being conducted at an old landfill site, it is very likely that some hazardous waste will be generated. Excavated materials will be field screened visually to identify stained soils or containers, and by field instruments such as a photo-ionization detector to determine if organic vapors are present. Materials determined by field screening as being potentially hazardous will be segregated and staged on 30-mil thick, 7 feet by 27 feet port-a-pads. The port-a-pads are manufactured with a pre-fabricated perimeter berm. Six port-a-pads will be available for this activity. If in the course of this activity the capacity of the six port-a-pads is exceeded, additional staging capacity will be developed on a minimum of 6-mil thick visqueen. Perimeter berms will be constructed to prevent runoff and run on. All soil and debris staging areas will be covered using visqueen and sandbags will be used as weights to keep the visqueen in place. All potentially hazardous material staging areas will be demarcated in the field.

Samples of potentially hazardous materials will be sent offsite for analysis. Within 48-hours of receipt of the samples, the offsite laboratory will verbally provide the field team with analytical results. Soil and debris determined to contain hazardous or toxic constituents will be immediately secured in a roll off container at the waste site and posted with adequate warning signs. If incompatible waste are identified, they will be kept segregated. For this characterization/remediation activity, DOE will remove this contaminated soil or debris to a permanent offsite treatment or disposal facility within 90-days. Soil and debris determined to not contain hazardous or toxic constituents will be released by the field team leader and will be used to backfill the trench upon closing.

Final transportation and disposal of the hazardous waste will be through the use of services currently provided by the WHC. USACE will initiate the Waste Storage/Disposal Request (WSDR) as outlined in WHC-EP-0063-4, Hanford Site Solid Waste Acceptance Criteria. WHC, using the sample analyses provided by USACE, will designate the waste according to WAC 173-303-70 and prepare the Hazardous Waste Disposal Analysis Record (HWDAR). Upon receiving the HWDAR, USACE will ensure that the hazardous waste is properly packaged and labeled in accordance with WHC-CM-2-14, Hazardous Material Packaging and Shipping and the instructions on the HWDAR. USACE will notify WHC to schedule shipments.

4.0 ASBESTOS WASTE

Asbestos awareness will be addressed in daily tailgate safety meetings to ensure all personnel that may come in contact with asbestos containing material (ACM) can identify possible ACM and are familiar with the difference between friable and nonfriable ACM as defined below. Workers will be instructed to immediately stop work in any area that possible ACM is located and contact a USACE representative for further instruction. Friable

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(regulated) asbestos waste will be handled in accordance with current state and federal regulations and disposed of at the licensed asbestos trench at the Central Landfill Facility (Chapter 7, WHC-EP-0063-4). Nonfriable asbestos waste will be returned to the excavation and covered with native backfill material. The following definitions are provided.

4.1 FRIABLE ACM

A term defined in 40 CFR Part 61, Subpart M and EPA 340/1-90-018 that means any material containing more than 1 percent asbestos, that when dry, can be crumbled, pulverized, or reduced to powder by hand pressure. All friable asbestos is regulated.

4.2 NONFRIABLE ACM

A term defined in 40 CFR Part 61, Subpart M and EPA 340/1-90-018 that means any material containing more than 1 percent asbestos, that when dry, cannot be crumbled, pulverized, or reduced to powder by hand pressure.

4.3 CATEGORY I NONFRIABLE ACM

A term defined in 40 CFR Part 61, Subpart M and EPA 340/1-90-018 that means asbestos-containing packing, gaskets, resilient floor covering, and asphalt roofing products containing more than 1 percent asbestos.

4.4 CATEGORY II NONFRIABLE ACM

A term defined in 40 CFR Part 61, Subpart M and EPA 340/1-90-018 that means any material, excluding Category I Nonfriable ACM, containing more than 1 percent asbestos, that when dry, cannot be crumbled, pulverized, or reduced to powder by hand pressure.

5.0 CONCURRENCE

The State of Washington Department of Ecology, as the lead regulatory agency, is requested to concur with the proposed plan prior to initiation of field activities. In addition, DOE and EPA concurrence is also desired. By concurring below all parties agree with this plan allowing the field activities to proceed.

4/18/94 — Ecology Representative

4-18-94 — EPA Representative

4/18/94 — DOE-RL Representative

4/18/94 — USACE Representative

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